JAN 27 1958

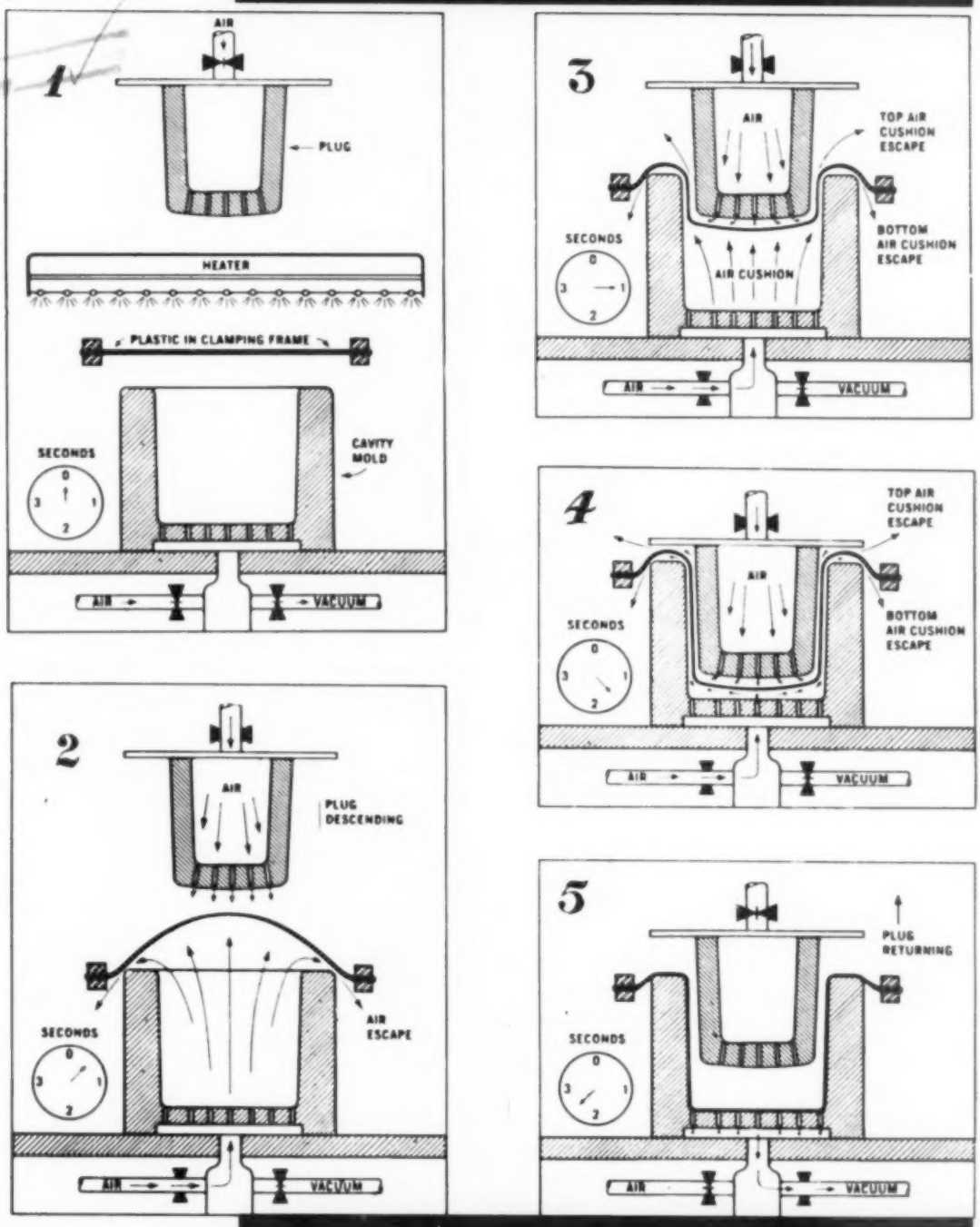
B 692660

JANUARY 1958

LIBRARY OF CONGRESS SERIAL RECORD
FEB 12 1958

PLASTICS TECHNOLOGY

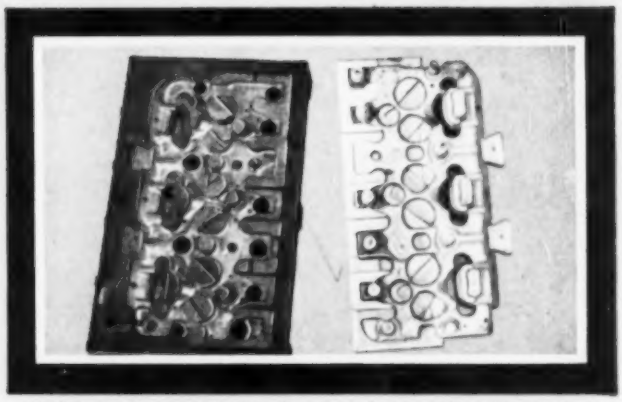
THE MAGAZINE OF APPLIED ENGINEERING



A BILL BROTHERS PUBLICATION

EPON® RESIN does it!

Speeds up International Harvester's Milwaukee Works' pattern modifications 65% ...cuts costs 50%!



Minimizes costs of design changes—International Harvester saved $2000 by making design modifications on an Epon resin model (right) of original drag jacket corebox (left).

Both model and mold are produced from an Epon resin-glass cloth laminate made for International Harvester's Milwaukee Works by Kish Industries, Inc., Lansing, Michigan.

Epon Resin simplifies pattern production—Epon resin faced cope and drag patterns for an IH engine can be drawn from molds with little danger of sticking.

Here's how:

AT INTERNATIONAL HARVESTER CO., world-famous manufacturers of farm equipment, Epon resins have created a money-saving revolution in foundry pattern modification.

For example: to enlarge the cross section of a frame casting for an IH crawler tractor, a pattern change would normally require 3 weeks and cost $700. *But by applying Epon resin . . . costs dropped to $300 . . . and the pattern was back in production in 1 week!*

In another situation, the use of Epon resin to make a plastic core model of a new drag jacket corebox from the old one saved IH over $2000.

In many fields of industry, the Epon resins are making such savings possible because they have ideal properties for tooling applications:

- Exceptional dimensional stability . . . high impact strength . . . excellent resistance to abrasion . . . minimum residual stress in cured parts.
- Ease and speed of preparation.
- Low shrinkage in filled formulations, assuring perfect master reproductions; minimum warping and stresses.
- Adaptability to repairs and design changes.
- Minimum finishing requirements for smooth surfaces.

Can Epon resin tools and dies make comparable improvements and savings in *your* operations? Find out now by writing your tooling resin formulator.

SHELL CHEMICAL CORPORATION

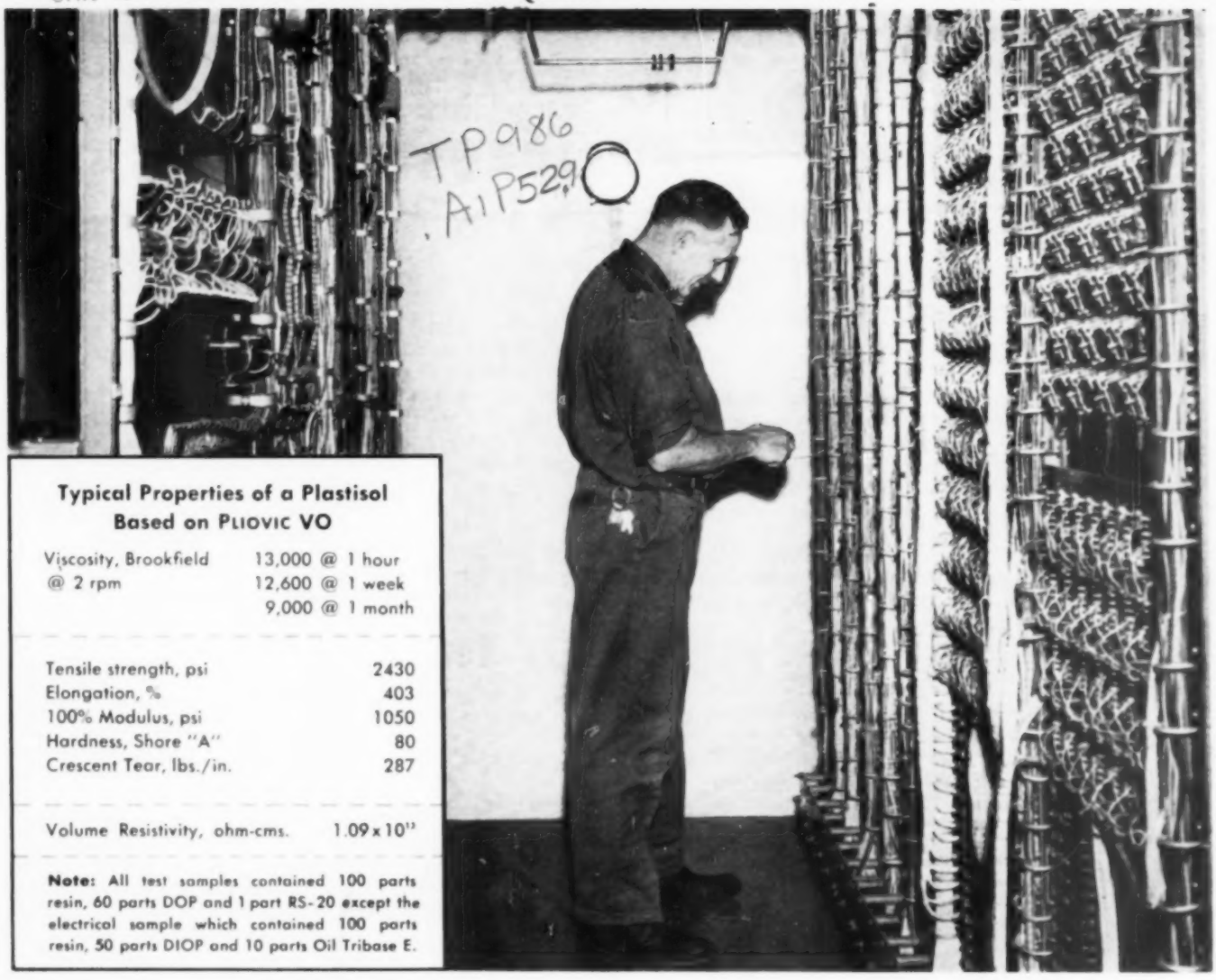
CHEMICAL SALES DIVISION, 380 Madison Avenue, New York 17, New York

Atlanta • Boston • Chicago • Cleveland • Detroit • Houston • Los Angeles • Newark • New York • San Francisco • St. Louis
IN CANADA: Chemical Division, Shell Oil Company of Canada, Limited • Montreal • Toronto • Vancouver

SHELL

PLASTICS TECHNOLOGY, published monthly by PLASTICS TECHNOLOGY PUBLISHING CORP., a division of BILL BROTHERS PUBLISHING CORPORATION. Office of Publication, 1309 Noble Street, Philadelphia, Pa., with Editorial Executive Offices at 386 Fourth Avenue, New York 16, N. Y. Subscriptions in United States and possessions and Canada $5.00 per year. All other countries $10.00. Accepted as controlled circulation publication at Philadelphia, Pa.
Copyright 1958 by Plastics Technology Publishing Corp.
Please send changes of address to the New York office

JAN 27 1958 B 692660 B 692660



Typical Properties of a Plastisol Based on PLIOVIC VO

Viscosity, Brookfield @ 2 rpm	13,000 @ 1 hour 12,600 @ 1 week 9,000 @ 1 month
Tensile strength, psi	2430
Elongation, %	403
100% Modulus, psi	1050
Hardness, Shore "A"	80
Crescent Tear, lbs./in.	287
Volume Resistivity, ohm-cms.	1.09×10^{13}

Note: All test samples contained 100 parts resin, 60 parts DOP and 1 part RS-20 except the electrical sample which contained 100 parts resin, 50 parts DIOP and 10 parts Oil Tribase E.

New—and purely superior!

If you're looking for something new and different in dispersion resins, particularly for use in electrical applications, you can stop right now. For in new PLIOVIC VO, we have just that.

PLIOVIC VO is a straight polyvinyl chloride resin of exceptional purity. It is designed and made for use in plastisols and organosols for electrical applications, for rotational and slush molding, for metal coatings and for dip coatings.

Compounds based on PLIOVIC VO exhibit the following characteristics: 1. Extremely low initial viscosity. 2. Outstanding shelf stability. 3. Superior electrical properties. 4. Excellent heat stability. 5. Good physical properties. 6. Exceptionally low water absorption. 7. Good film clarity.

Plastisols made with PLIOVIC VO are effectively protected against heat and light with small amounts of economical zinc-type stabilizers. They also are readily deaerated to assure uniform cross sections. And they exhibit a very desirable, dry, nongreasy feel. For full details, including the latest *Tech Book Bulletins*, on the new PLIOVIC VO, the unique PLIOVIC AO, or their blends, just write to: Goodyear, Chemical Division, Akron 16, Ohio.

CHEMIGUM
PLIOFLEX
PLIOLITE
PLIOVIC
WING-CHEMICALS

High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries

CHEMICAL
GOODYEAR
DIVISION

PLASTICS
DEPARTMENT

60 GOODYEAR

Chemigum, Pliolite, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

U.S.I.

Vol. III No. 1

POLYETHYLENE PROCESSING TIPS

PROCESSING CONDITIONS AFFECT STRESS-CRACK RESISTANCE OF POLYETHYLENE PRODUCTS

Most thermoplastic materials are subject in varying degrees to environmental stress-cracking . . . and polyethylene is no exception. Stress-crack failures may occur in polyethylene when the plastic is under high local stresses, either externally or internally applied, and in contact with soap, detergent or solvent.

Stress crack resistance depends on the resin used, and the processing conditions. The effect of polyethylene resin properties were discussed in the last issue of TIPS. This issue will be devoted to the effect of processing conditions.

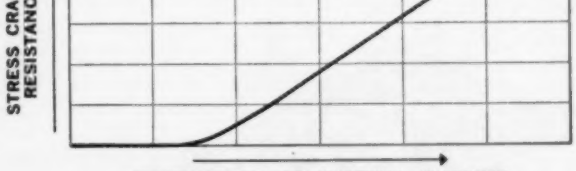
Apart from outside forces, there are, for a given polyethylene resin, two main causes of stress-cracking: locked-in stresses, and a high degree of molecular orientation. Locked-in stresses arise from uneven shrinkage during cooling. In molecular orientation, polyethylene molecules are comparable to iron filings in a magnetic field; they line up in force or stress patterns which, in effect, are stress concentrations along which fractures may occur.

Mold design affects stress cracking

To improve the stress-crack resistance of molded polyethylene, the molder should select his resin carefully on the basis of mold design, injection and mold temperatures, and, of course, the properties he wants in his end product.

Here, for example, is one way in which mold design can influence the choice of a resin: It is *generally* true that resins of higher molecular weight have relatively high stress-crack resistance. But in deep-draw molded items, or those with large cross-sections, resins of low molecular weight often yield a product with better stress-crack properties. This is because resins of low molecular weight—and hence, lower viscosity—permit the mold to fill more quickly. Under these conditions the material cools at a more uniform rate and fewer internal stresses are created.

Different flow rates, due to abrupt changes in mold cross-section or to sharp corners, may create points of stress concentration. These cannot always be eliminated, since every design is a compromise between mold engineering and product design.

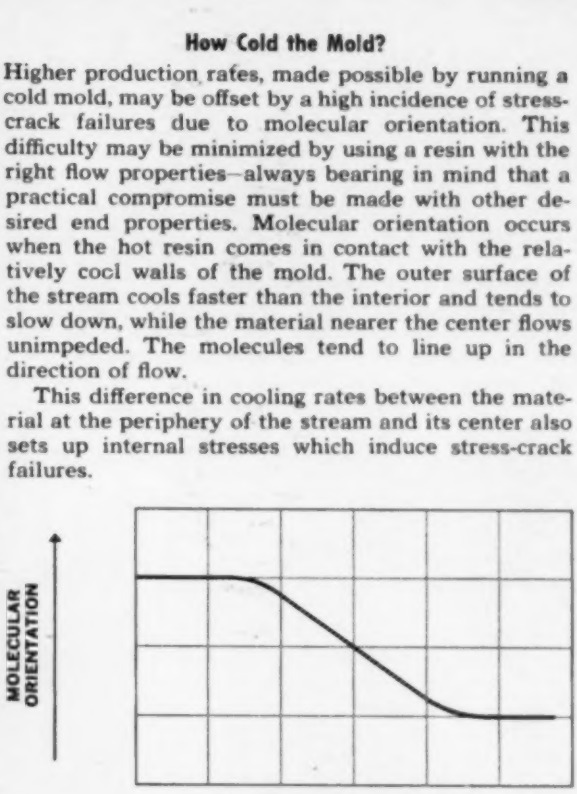


Stress crack resistance increases with higher stock temperatures in injection molding.

How Cold the Mold?

Higher production rates, made possible by running a cold mold, may be offset by a high incidence of stress-crack failures due to molecular orientation. This difficulty may be minimized by using a resin with the right flow properties—always bearing in mind that a practical compromise must be made with other desired end properties. Molecular orientation occurs when the hot resin comes in contact with the relatively cool walls of the mold. The outer surface of the stream cools faster than the interior and tends to slow down, while the material nearer the center flows unimpeded. The molecules tend to line up in the direction of flow.

This difference in cooling rates between the material at the periphery of the stream and its center also sets up internal stresses which induce stress-crack failures.



Molecular orientation is decreased with higher stock temperatures.

Mold Release Agents have some effect

Mold release agents may be of some benefit, as they tend to reduce the "drag" effect. However, caution must be used in their selection, since certain materials may induce stress cracking.

Compromise is often necessary

While no simple answer exists to the problem of stress-cracking in polyethylene products, resistance can usually be brought to a satisfactory level by choosing the best resin, making adjustments in molding temperatures, cooling rates and mold design. Since certain compromises must always be made, in selecting a resin and in processing techniques, processors can frequently use the services of a resin specialist. U.S.I.'s Technical Service Engineers are ready to discuss your processing problems, and to help in every way to solve them.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N.Y.
Branches in principal cities

PLASTICS TECHNOLOGY THE MAGAZINE OF APPLIED ENGINEERING

JANUARY 1958 VOLUME IV NUMBER 1

4 *ARTICLE HIGHLIGHTS and PREVIEWS*

35 **MOLD DESIGN TECHNOLOGY FOR POLYETHYLENE** . . . R. W. VanSickle
Part design and mold components, rigidity, and temperature control can be tailored to fit the special needs of polyethylene injection molding.

40 **CHANGES IN PT EDITORIAL ADVISORY BOARD**

41 **REINFORCED EPOXY SPRAY MASKS FOR TWO-TONE PAINTING** C. B. Martin
The fabrication, utilization, and repair of masks used for two-tone painting of shrouds for out-board motors.

44 **DEEP-DRAW VACUUM FORMING**

45 *GUEST EDITORIAL:*
BASIC RESEARCH FOR THE PLASTICS INDUSTRY . . Jerome L. Formo

46 **PLASTIC PIPE IN THE CHEMICAL PROCESS INDUSTRY** . . R. B. Seymour
The present status of plastic pipe for combating corrosion in chemical processing.

51 **SIGNIFICANCE OF SECOND-ORDER TRANSITIONS OF POLYESTER AND EPOXY RESINS IN GLASS FIBER-REINFORCER LAMINATES** A. D. Coggeshall
Exhaustive tests show the resins to have a characteristic temperature- and stress-dependent rheology that requires use of appropriate stresses for duplication in laminates.

60 **PLASTIC SOLVES CASTING PROBLEM**

PLASTICS TECHNOLOGY ENGINEERING FORUM:

61 **MOLDING AND TOOLING** . . . . . Ernest J. Csaszar
Moldmaker Apprenticeship Training

62 **REINFORCED PLASTICS** . . . . . Harry T. Douglas
Reinforced Plastics in Outer Space

63 **COMPRESSION & TRANSFER MOLDING** . . . J. B. Lidstone

FEATURE DEPARTMENTS

4 Letters to the Editor
21 News in Brief
13 Editorial
65 News of the Societies
96 Calendar of Coming Events
70 News of Industry
73 Names in the News
74 News from Abroad
76 New Materials
79 New Equipment
83 Plastics Applications
87 New Literature
88 Book Reviews
89 Abstracts of Important Articles
92 Patent Digest
97 Resins: Production & Sales

96 Current Market Prices

JOHN W. HARTMAN
President

ROBERT B. CARTER
Vice President

FREDERICK C. KENDALL
Vice President

EDITORS

ARTHUR M. MERRILL
Editor

ROBERT G. SEAMAN
Consulting Editor

JAMES T. DUGAN
Associate Editor

CHARLES C. ORR
Assistant Editor

FLORENCE NEWMARK
Editorial Assistant

L. THAKAR
Foreign Editor

DR. JAY GOULD
Market Statistics

FRANCES Y. McHUGH
Production Manager

EDITORIAL ADVISORY BOARD

Materials
C. H. ADAMS
A. P. LANDALL
R. L. KNAPP
B. THAYER

Moldmaking
E. J. CSASZAR

Equipment
H. E. BUECKEN
E. H. JOHNSON
E. B. STRATTON

Processing
SAUL BLITZ
H. T. DOUGLAS
G. S. LAAFF
J. H. WOODRUFF

BUSINESS STAFF

ROBERT B. CARTER
Business Manager

LEE R. NOE
Eastern Representative
386 Fourth Avenue
New York 16, N. Y.
LExington 2-1760

WILLIAM T. BISSON
Mid-West Sales Manager
163 West Exchange Street, Room 27
Akron 8, Ohio
FRanklin 6-3434

C. E. LOVEJOY, JR.
Western Manager
333 N. Michigan Ave., Chicago 1, Ill.
STate 2-1266

ROBERT E. AHRENSDORF
Pacific Coast Representative
1140 Wilshire Blvd., Los Angeles 17
MAdison 9-2681

DONALD E. KERWIN
260 Kearny Street, San Farncisco 8
EXbrook 7-0690

ALBERT R. WILSON
Circulation Manager

Chairman of the Board, Philip Salisbury. President, John W. Hartman. Treasurer, Ralph L. Wilson. Vice Presidents, B. Brittain Wilson, C. E. Lovejoy, Jr., Wm. H. McCleary. Editorial and Executive Offices, 386 Fourth Ave., New York 16, N. Y. LExington 2-1760. Subscription Price: United States and Possessions and Canada, $5.00 per year. All other countries, $10.00. Single copies in the U. S., 50¢; elsewhere, 75¢. Other Bill Brothers Publications: In Industry: Rubber World. In Marketing Sales Management, Sales Meetings, Tide, Premium Practice. In Merchandising: Floor Covering Profits, Fast Food, Tires-TBA Merchandising. Members of Business Paper Audit of Circulations, Inc. and National Business Publications, Inc.

Cover diagrams courtesy of The Auto-Vac Co.

PUBLISHED MONTHLY BY

Plastics Technology Publishing Corp., a Division of

BILL BROTHERS PUBLISHING CORPORATION

386 FOURTH AVENUE, NEW YORK 16, N. Y.

The opinions expressed by our contributors do not necessarily reflect those of our editors.

NBP BPA

Article

Highlights

Mold Design Technology for Polyethylene. (p.35)

Mold design technology to cover some of the special needs for injection molding of polyethylene requires fundamental consideration of such factors as sprues, runners, and gates as molding components; mold temperature control; part design; mold rigidity; and mold feeding system.

•

Reinforced Epoxy Spray Masks for Two-Tone Painting. (p. 41)

Two-tone painting of covers or shrouds for outboard motors presents problems because of contour complexity and the need for a smooth parting line between the two color coats on the same shroud. These problems have been overcome by using spray masks of reinforced epoxy which are sufficiently flexible to adjust for variations in shroud dimensions, but are rigid enough to allow firm clamping.

•

Plastic Pipe in the Chemical Process Industry. (p. 46)

Based on many successful applications, thermoplastic resin pipe is an acceptable material of construction. Major advantages are good resistance to corrosive solutions, smooth pipe interiors, and lower specific gravities than most other types of pipe.

•

Significance of Second-Order Transition of Polyester and Epoxy Resins in Glass Fiber-Reinforced Laminates. (p. 51)

Apparent temperature of transitions is shown to be a function of stress on the resin. This stress can be varied by changing the specimen load or reinforcement. Comprehensive data is given to show that the resins have a characteristic rheology dependent on temperature and stress.

Previews

The following articles will be published in the February issue:

Some Aspects of the Stabilization of Vinyl Insulation. J. G. Hendricks and N. L. Cooperman, Research Labs, National Lead Co., Brooklyn, N. Y.

Measuring the Abrasion Resistance of Plastic Lenses for Sunglasses. P. M. Kamath and H. O. Buzzell, Polaroid Corp., Cambridge, Mass.

A Control Program for Epoxy-Caused Dermatitis. J. A. Stifter, pres., Milburn Co., Detroit, Mich.

Evaluating Epoxy Resin Degradation Systems. W. G. Murray, plastics lab. technician, and G. A. Stein, plastics research dir., A. O. Smith Corp., Milwaukee, Wisc.

Letters to the Editor

Comments on Manpower Education

Editorials

Dear Sir:

I have noted, with some disfavor, the recent appearance in your magazine of several editorials which implied that little has been done or is being done to establish and further plastics education on a practical level.

Your September editorial, "Training and Educating Plastics Manpower," advised that the plastics industry is in need of "formal education with emphasis on actual plastics practice," and your October guest editorial on "The Need for Proper Molder Education" reiterated this theme.

I am pleased to advise that there are many of us in the plastics industry who are aware of the problems set forth in these editorials, and even more pleased to announce that a planned education program aimed at filling the personnel requirements of the processing branches of the industry has been in successful operation in the Newark, N. J., area for nearly two years.

This is a full-fledged Plastics Engineering Technology Program being given in the Special Courses Division of the Newark College of Engineering.

Two separate plastics courses are offered in the program: Process Properties of Plastics, Compression and Transfer Molding, Injection Molding, Extrusion of Plastics, Plastic Mold Design, Plastic Product Design, Auxiliary Tooling for Plastics, Testing and Control of Plastic Properties, Thermoplastic Process Techniques, and Thermosetting Process Techniques.

The program was founded at N.C.E. under the sponsorship of the Newark Section of the Society of Plastics Engineers, Inc., which furnishes the instructors for the courses and, in conjunction with the college, organizes the plastics curricula.

Completion of the full three-year program, which includes courses in Engineering Mathematics, Report Writing, Effective Speaking, Mechanics, Mechanics of Materials, Engineering Drawing, Plant Layout & Material Handling, Instrumentation, Industrial Safety, and Problems of Supervision, earns the student a certificate in Plastics Engineering Technology.

Your editorial, and Mr. Young's, expresses the need for just this type of program, and it was somewhat discouraging to note that, despite the publicity we have attempted, neither of you apparently has heard of the program.

A. G. Serle, Chrmn., Education Committee,
Newark Section, Society of Plastics Engineers, Inc.
Newark, New Jersey

(We are pleased to print this letter to correct Mr. Serle's erroneous impression that we are not aware of the Newark Section's work in educating plastics manpower. Our editorials actually are dictated by the readers; when enough letters and phone calls are received here on a certain topic, that topic becomes the subject of an editorial. Plastics manpower education is a subject of interest throughout the plastics industry nationally, and some type of national education program is needed. By printing this letter, we are happy to give proper recognition to the SPE Newark Section for its awareness of the educational problem, and the steps it has taken to meet the need for manpower education.—Editor)

• • •

Lack of Proper Data

Dear Sir:

I heartily agree with Mr. Douglas in his Forum article in the November issue (p. 914). I had a similar experience with "general purpose" polyester resins.

We have a "special formula" polyester designed for casting and embedding. After a lot of cut-and-try many years ago, we also discovered a team of catalyst and promoter to go with it, providing a fool-proof casting operation. Last spring, disturbed by general talk about mergers, transportation strikes and management reorganizations to cut costs, I decided to have a second supplier in reserve.

I contacted ten suppliers of polyester resin. After six weeks, two of them sent samples of a "general purpose"

resin represented to be good for casting. The other eight had pretty flimsy reasons for not having a castable resin, or else did not answer at all.

Both G-P resins seemed exactly alike, but neither would harden or even jell with two commonly available catalysts. Being stubborn, I finally made one work by using a high potency catalyst four times as expensive, plus 200° F. jell/cure heat even to get a jell. It worked, but certainly wasn't commercially acceptable.

The supplier would not commit himself to a clear-cut statement that a certain catalyst was O.K. or suggest a work schedule, with or without a promoter chemical. Yet the supplier reportedly does a tremendous business with their impregnating resins.

Most technical data sheets I see are almost incomprehensible except to another plastics chemist. They certainly don't help the sales department. The burden of proof is on the supplier, not on the user; he is the prospective customer. His "spending money" was earned the hard way. Just one mistake might wipe out several months of net profit.

What is needed in the polyester business is fast action in the office; letters written by men who know more than the average customer, and in detail, as a one-shot sales package. All resin samples sent out should include a 2-oz. sample of the proper catalyst, with information on alternative types, and also a sample of promoter in the case of a casting application. An envelope of easy-to-understand direction sheets should come with the sample kit.

This would be an expensive operation, unless sample requests from schoolteachers, science students, amateur experimenters, inventors, and part-time basement "manufacturers were excluded. This type of trade can be handled better by suppliers of low cost experimenters' kits, of which there are several.

Frank Pray, Owner,
Technicraft Co.
Boston, Mass.

• • •

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identity of the writer will be withheld, if desired.

—The Editor

IS A-C POLYETHYLENE "X"* THE X FACTOR IN YOUR PROCESS?

Stories of successful application of A-C POLYETHYLENE are pouring in from so many fields and industries that we haven't had an opportunity to explore the apparently limitless uses of this exciting new polymer. So we're asking you! If your field of operation is even remotely similar to those below, it is very probable that A-C POLYETHYLENE can give you increased sales, lower costs and many other advantages. Find out today!

Look what it's done for others!

X **Injection Molders** are getting shorter cycles, complete control of flow, higher gloss, sure mold release, with the ability to mold larger and more intricate parts.

X **Polish Makers** use it in its emulsifiable form and call it the "Polish Maker's Polyethylene". They're getting finish durability, non-slip properties, and rebuffability!

X **Paper Converters** use it as a hot melt and are enthusiastic about the low-cost quality coating it offers. Grease resistance, scuff resistance and single feed to automatic machines are other advantages!

X **Dairy Carton Coaters** add it to waxes for their cartons, getting longer shelf life and reducing flaking, leaking and bulging!

X **Food Packagers** like the smarter, glossier appearance of their packages—less rub-off and scuff. Printing looks better, too!

X **Box Makers** coat interior surfaces of corrugated cartons with an A-C POLYETHYLENE-Paraffin blend to eliminate the need for liners! Scratch from paper fibers on fine finishes is eliminated!

X **Textile Finishers** find A-C POLYETHYLENE surprisingly versatile for sizes or finishes. Excellent hand, sewability, durability, abrasion resistance and many production advantages result from using this polymer!

X **Ink and Paint Manufacturers** are satisfied that A-C POLYETHYLENE adds anti-smudge and scuff resistance characteristics to their products!

X **Slush Molders** use A-C POLYETHYLENE with other polyethylenes and end up with a "brand new" material, giving them simpler production with lowest mold costs. The finished articles are tough, colorful and have fine detail!

X **Film Extruders** are using A-C POLYETHYLENE for faster extrusion rates, lower machine temperatures, easier gauge control and less all around machine stress. A-C POLYETHYLENE is a natural for coloring films. Color concentrates made with A-C POLYETHYLENE produce brilliant, uniformly colored film!

X **Squeeze Bottle Makers** are praising the glossy finish and even color when using A-C POLYETHYLENE. They like the faster molding operation, too!

X* = PROFITS, QUALITY, PRODUCTION...

When it's A-C® Polyethylene

LET US SHOW YOU HOW A-C POLYETHYLENE CAN BE THE "X" FACTOR IN YOUR PROCESS!

Mail coupon today!

SEMET-SOLVAY PETROCHEMICAL DIVISION
Allied Chemical & Dye Corporation
Room No. 523-R
40 Rector Street, New York 6, N. Y.

Allied Chemical

We manufacture _____

Please send information indicating how A-C POLYETHYLENE can help us.

Name _____

Company _____

Address _____

City _____ Zone _____ State _____

IT'S YOUR MONEY

that's being wasted at the rate of $13,700,000 a day

at a time when our country needs every available dollar for missile development

You, as a taxpayer and a businessman, have a big stake in the recommendations of the bipartisan Hoover Commission. *Plastics Technology* believes it will pay you well to know more about it...

In 1953 Congress, acting unanimously, asked twelve men to:

1. Recommend ways to make the Executive Branch operate more efficiently and economically (more like a business).
2. Recommend the elimination of non-essential services in competition with private enterprise.
3. Propose broad and original policy changes that would reduce waste; improve government efficiency – including Constitutional amendments if necessary (just as a business changes policies to cope with the economic facts of life).

This Hoover Commission, working with 19 "task force" research committees composed of 200 volunteer experts, many recruited from business, developed 314 recommendations, of which 156 have been adopted.

Billions have been saved. But what happens from now on can release vast additional funds for today's urgent needs. Congressional action in the early months of 1958 depends – more than you think – on you.

How to keep informed

You, as a business man, are eligible to become a member of the Citizens Committee for the Hoover Report, a non-profit, bipartisan organization with thousands of volunteer members. These citizens, in and out of government, represent the only force organized to follow through on Hoover Report recommendations. You can do your part by joining with thousands of other business men as a member of this Citizens Committee.

There is no need to tell you, a responsible citizen and business man, the danger of letting billions of dollars go down the drain by default.

There is a need, perhaps, to inform you through your own business magazine what *you* can do ... in your own business, in your own community ... to help cut government waste. For this reason we, as a member of *Bill Brothers Publishing Company*, feel a deep responsibility to keep you informed. If you would like to become a regular member of the Citizens Committee for the Hoover Report, use the coupon below. There's no obligation ... except as you may elect to aid in this important effort.

If you're for a waste-free, streamlined Federal Government, send this coupon ⇩

PLASTICS
TECHNOLOGY

A BILL BROTHERS PUBLICATION
386 Fourth Avenue, New York 16, N. Y.

FAST FOOD • FLOOR COVERING PROFITS PLASTICS TECHNOLOGY • PREMIUM PRACTICE • RUBBER WORLD • SALES MANAGEMENT • SALES MEETINGS TIDE • TIRES TBA MERCHANDISING

BILL BROTHERS PUBLICATIONS

PLASTICS TECHNOLOGY
Bill Brothers Publications
386 Fourth Avenue, New York 16, N. Y.

Yes, I would like to receive, without obligation, a membership card for the *Citizens Committee for the Hoover Report* and a copy of the Committee Member's Handbook, Reorganization News, and other materials.

name _____

title _____

company _____

address _____

city _____ zone _____

state _____

For Vinyl Electrical Insulation that Resists High Temperature at High Humidity...

PARAPLEX G-54

Formulators of vinyl compounds should be particularly interested in PARAPLEX G-54—vinyl compounds containing PARAPLEX G-54 are especially well suited for high-temperature insulation used under "wet" conditions. This new Rohm & Haas plasticizer was specifically designed to provide freedom from exudation (spew) on exposure to high humidity at elevated temperatures.

Vinyl compounds plasticized with PARAPLEX G-54 also show better volume resistivity . . . outstanding retention of elongation after high-temperature exposure . . . superior plasticizing efficiency . . . high dry dielectric strength and very good retention of dielectric strength after immersion in water . . . excellent resistance to copper corrosion . . . compatibility with stabilizing plasticizers . . . outstanding resilience.

For more detailed information about all Rohm & Haas plasticizers and their applications, send for *What You Should Know About* PARAPLEX *and* MONOPLEX *Plasticizers.*

PARAPLEX *and* MONOPLEX *are trade-marks, Reg. U.S. Pat. Off. and in principal foreign countries.*

Chemicals for Industry

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

Monsanto *Polyethylene* Resins

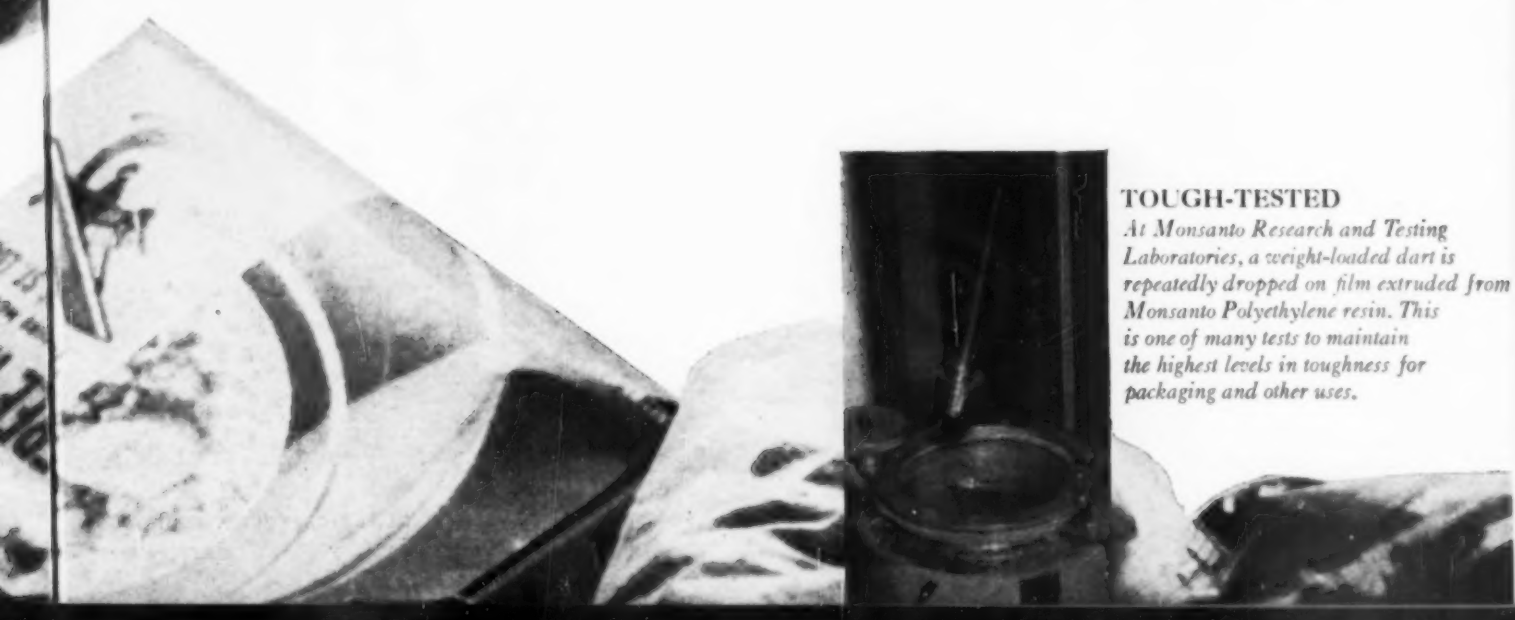
—formulated for the toughness that satisfies ...and sells!

Toughness that means fewer film rejects... tougher film that takes the roughest handling without tearing . . . toughness that opens up more and more uses for polyethylene film. This toughness that means customer satisfaction starts with special tough-grade polyethylene resins developed by Monsanto research.

Monsanto special tough-grade polyethylene resins are available for extruding and calendering film. Other special formulations have been developed for wire and cable insulation, extrusion coating, tubing, profile shapes, and moldings.

Write for detailed information to Monsanto Chemical Company, Plastics Division, Room 1861, Springfield 2, Mass.

MONSANTO®



TOUGH-TESTED

At Monsanto Research and Testing Laboratories, a weight-loaded dart is repeatedly dropped on film extruded from Monsanto Polyethylene resin. This is one of many tests to maintain the highest levels in toughness for packaging and other uses.

IN MOLDING—

No job's "too tough"

Proctor iron handle molded of BMG-5498 for excellent appearance, mold fill-out and lower rejects. Small electrical parts molded of BMM-7000 for faster cure and good electrical properties.

for "BAKELITE" PHENOLICS
BRAND

HERE'S WHY

The wide variety of formulations available to you, from one single source—in BAKELITE Brand Phenolics — assures fabrication success — no matter what your problem. Along with precision moldability, you achieve the best combination of properties to suit the application. You save time in finishing and—you *cut* production costs.

HERE'S HOW

As a case in point, consider BMM-7000, a new BAKELITE Brand fast-cure, two-step phenolic for general purpose molding. This formulation reduces cure time as much as 50%. Supplied in special, low fines granulations, BMM-7000 has perfect balance of molding latitude and cure speed, faster mold-closing speed, and good mold release.

HERE'S WHERE

At Bakelite Company, there are phenolics engineered for electrical properties, resistance to shock, water, heat and chemicals. Technical publications containing specific data on physical, mechanical and electrical properties are available on request to your Bakelite Company representative.

BAKELITE
BRAND
PLASTICS

PHENOLICS • VINYLS • STYRENES
POLYETHYLENES
IMPACT STYRENES • EPOXIES
C-II STYRENES

Products of UNION CARBIDE *Corporation*

BAKELITE COMPANY, *Division of Union Carbide Corporation*
30 East 42nd Street, New York 17, N. Y.

The terms BAKELITE and UNION CARBIDE are registered trade-marks of UCC.

8-1023

1 FIRST OF A SERIES

Chemical Division GENERAL VYGEN

THE GENERAL TIRE & RUBBER COMPANY
CHEMICAL DIVISION • AKRON, OHIO

INTER-OFFICE MEMORANDUM

FROM: Purchasing Department

TO: Chief Chemist

SUBJECT: VYGEN PVC RESIN

The General Tire Chemical Division representative just left, after giving me some information on their line of PVC resins. From what he says, they certainly will help solve some of our production problems. These resins have also been recommended to me at the Purchasing Agents' Meetings by users. The resins are as follows:

Vygen 110—An average molecular weight general purpose resin recommended for calendered film, sheeting and coated fabrics, as well as for extrusion and molding operations. This resin could solve the flaws in the surface that we have had lately, which you said was due to gelled particles.

Vygen 120—A high molecular weight resin primarily adapted for extrusion operations from dry blend or pelletized compound. It is said to have maximum heat stability and low gell count, and has been approved by the UL for electrical applications. Since it has this approval, and can be dry blended with polymeric plasticizers and extruded from the dry blend, it sounds like a natural for that new wire coating job you have been working on.

Vygen 105—A low molecular weight resin for molding, calendering, and extrusions requiring a high gloss finish. It has excellent heat stability, and should do the job in our injection molding setup.

Vygen 161—A low bulk density - high plasticizer absorption resin of average molecular weight, recommended for use where high plasticizer-to-resin ratios are required. It will give a dry pre-blend even in an unheated pre-blender, and is generally used to make pigment color masterbatches. Sounds like an easy way of adding our colors.

General is stressing these specialized resins, tailored to fit the job, and offers excellent service, as well as superior quality. With warehouses throughout the country, and a modern plant at Ashtabula, Ohio, they give overnight delivery almost anywhere, in either straight or mixed carloads. The versatility of these resins allows them to fit many of our operations. Please evaluate them, and send the results along to Production with a carbon to me.

M. L. Wingate
Purchasing Agent

PLASTICS TECHNOLOGY

JANUARY, 1958

EDITORIAL: The Outlook for 1958

Despite some expressed pessimism and rumors to the contrary, industry's general outlook for 1958 is very good. The plastics industry, in particular, can anticipate an excellent year as plastics will continue to forge ahead in acceptance and volume of usage. The plastics industry will make further strides in achieving true maturity with increasing awareness of its responsibilities to itself and to its customers.

Leading the plastics industry's gains will be the polyethylenes (particularly the high density types), the epoxies, the polyamides (keep your eyes on the caprolactam types), the reinforced plastics, and the thermosetting resins. The thermosets are showing unmistakable signs of awakening from their long lethargy and moving ahead in both current and new fields of application. Good prospects are also in evidence for the other types of plastic resins. In fact, volume and sales totals for 1958 will be very good in all respects.

•

For business in general, the watchword is uncertainty; man-made uncertainty, at that. Some soft spots in the nation's economy have developed, but the general outlook still is bright. In too many places, however, it has become fashionable to be pessimistic, and many people seem to be waiting for the axe of depression to fall on them.

As a poet once wrote, "Nothing is, as well you know, but constant thinking makes it so!" All the facts of our economy point towards a continuing prosperity. Let's not delude ourselves into a self-induced depression.

Report to our Readers

In line with our policy of keeping you informed of results obtained in our annual Survey of Reader Interest polls, we can present some results from the 1957 Survey.

Replies to the question "How many people in your firm read *your* copy of PT?" showed that there are 5½ readers per copy. In addition, 51.23% of our subscribers retain the issues for their files. The readers also indicated that 57.71% like the magazine "as is" editorially; 16.60% would like more technical articles; 5.36% would like more non-technical articles; and 61.29% were enthusiastic in expressing their approval of the Engineering Forum columns and the annual series on Advances in the Technology of Plastics. This latter came as no surprise, since both the Forum and Advances were instituted in accordance with reader suggestions made in the 1956 Survey.

Now what of this year and the future? As mentioned in the past two editorials, we expect many changes and improvements in the magazine. These improvements will be starting as soon as we can set up for them, and will be announced in future editorials.

As indicated in the December editorial, we have many serious questions as to the feasibility and practicality of our possibly inaugurating a program of Achievement Awards in Plastics Technology. We requested comments and suggestions from our readers. Some replies have already been received, but we would like to have many more before plans can be finalized. Please take the time to write us about the Award program. All letters will remain confidential, and be given sober consideration. But please write soon!

Arthur M. Merrill

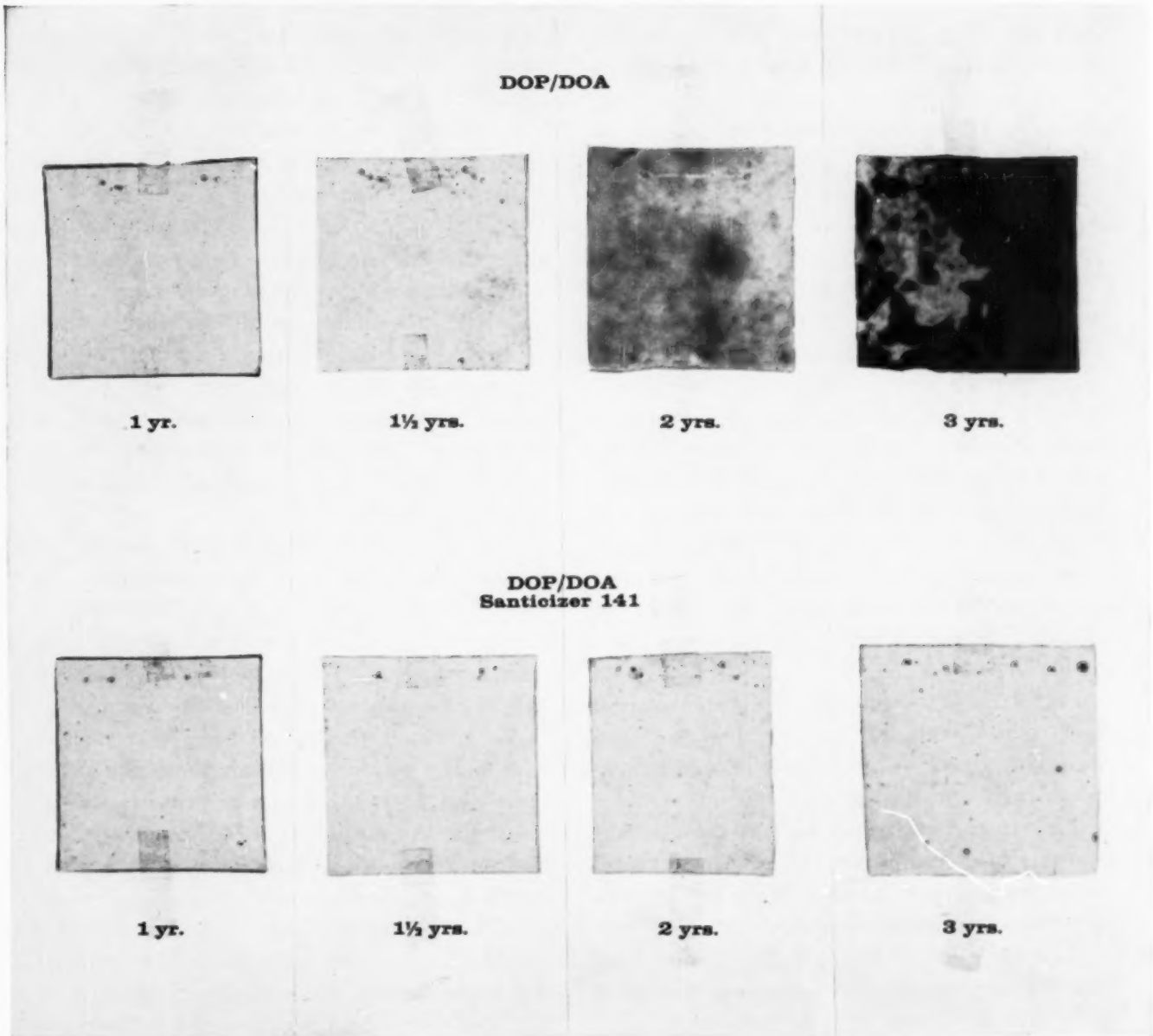
Editor

Low-cost light stability

Across-the-board approval for non-toxicity

Higher tear strength and flame retardance

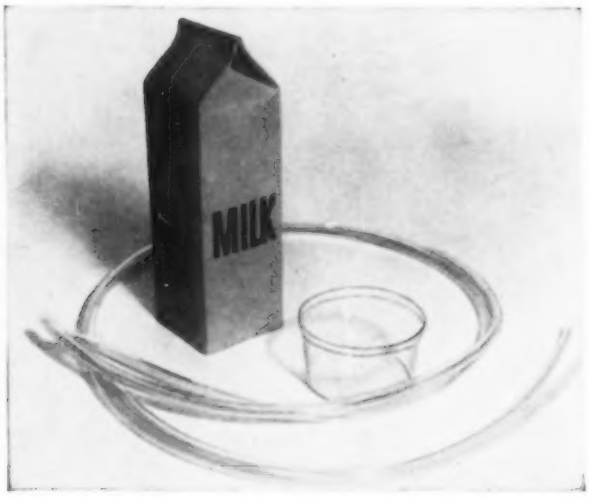
ONLY SANTICIZER 141 GIVES



1. Low-cost light stability

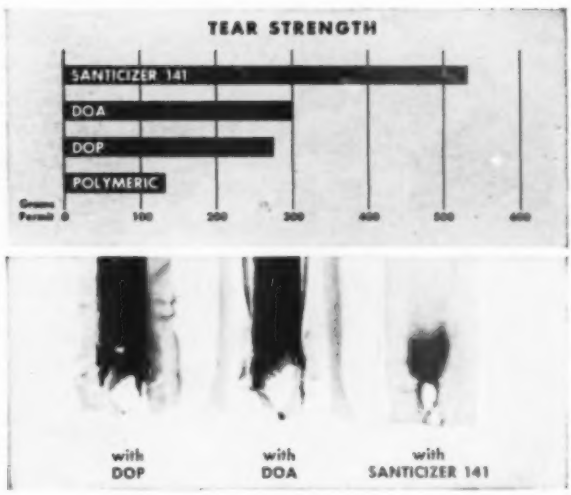
These samples from a 3-year outdoor exposure study show the excellent light stability that is inherent in Santicizer 141. Control compounds (40-mil sheeting) plasticized with a blend of DOP and DOA began to fail in slightly over one year. Experimental samples in which five parts of Santicizer 141 replaced five parts of DOP show no visible deterioration even after two years of severe St. Louis climatic conditions—with only slight degradation after three years. Yet Santicizer 141 is a low-cost primary plasticizer!

YOU ALL THESE ADVANTAGES



2. Across-the-board approval for non-toxicity

If you're interested in the food packaging, tubing, and surgical supplies market, here's a valuable fact: Santicizer 141 meets the requirements of both the Food and Drug Administration and the Bureau of Animal Industry. Because Santicizer 141 has this across-the-board approval, you can use it for food packaging and plastic products intended for close contact with animal or human bodies.



3. Higher tear strength and flame retardance

Films plasticized with Santicizer 141 may have as much as *double* the tear strength of those plasticized with straight DOP. Santicizer 141 also imparts superior low-temperature flexibility, resistance to embrittlement on aging. And it has excellent flame-retarding properties: flame-out time is only three seconds for polyvinyl chloride plasticized with Santicizer 141 at 50 parts per 100 parts of resin.

WANT TO IMPROVE ANY OF THESE PRODUCTS?

To improve the light stability of curtains, floor tile, films . . .

To improve the non-toxicity of plastic surgical supplies, tubing, food wrappings and containers . . .

To improve the tear resistance and flame retardance of belting, tapes, upholstery, rain wear . . .

Our Technical Service Department will help you test Santicizer 141 in your operation. Monsanto supplies almost FIFTY different plasticizers of SEVEN basic types. Call on Monsanto for one-stop service, mixed bulk shipments at bulk prices, and expert technical advice.

MONSANTO CHEMICAL COMPANY
Organic Chemicals Division
Dept. PL-5, Box 478, St. Louis 1, Mo.

With no vested interest in any single plasticizer, Monsanto develops plasticizing systems tailor-made to fit your needs.

SANTICIZER: Reg. U. S. Pat. Off.

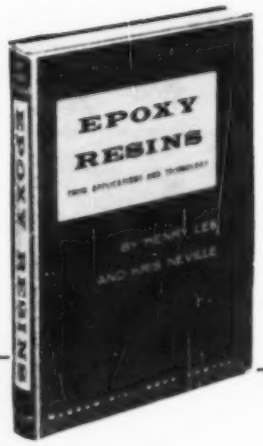
MONSANTO®

WHERE CREATIVE CHEMISTRY WORKS WONDERS FOR YOU

The versatile EPOXY RESINS! . . .

How they work—strong and weak points—how to use them in industry

Materials and processes, properties, handling methods—the whole range of information needed to make effective industrial use of epoxy resins is covered concisely and soundly in this book. Applications in industrial castings, surface coatings, high-strength adhesives, durable laminates, solders, lightweight foams, and potting compounds are covered, against a background of the chemistry and technology of the basic resins and their reactions in curing. Also including many data in tabular and graphical form, the book will enable you to begin with a particular application, of specific performance requirements, and to formulate a compound that will very closely approach your needs.



Just Published

EPOXY RESINS

Their Applications and Technology

By HENRY LEE and KRIS NEVILLE

The Epoxylite Corporation

305 pages, 176 illustrations, 87 tables, $8.00

THIS book provides a comprehensive guide to the new field of epoxy resins, covering the chemistry of their preparation and their applications in industry.

The available data on the resins are brought together, and information given on their synthesis and curing mechanisms, curing agents, and the various materials used as fillers and modifiers, with emphasis on the engineering versatility, range, and potentialities of the epoxies.

In specific terms, the book discusses the industrial applications for the resin systems in a varity of cases where superior product performance may be obtained by their use.

Application techniques are discussed, handling characteristics are considered in detail, and the methods for characterizing both cured and uncured resins are presented. On the basis of the extensive tabular and graphic data included, practical formulations are developed for a number of industrially valuable compounds.

In all, here is information of the most practical sort for you, not only prepared by specialists in the field, but also reviewed, and with contributions included, by 20 other specialists in firms intimately concerned with epoxy resins.

Crammed with practical information on such topics as:

—synthesis of the basic epoxy-resin molecule
—synthesis of mixed resins
—commercial epoxy resins
—resin characteristics
—curing by crosslinking agents
—effect of chlorine content
—calculation of amount of curing agent to use
—degree of cure
—characterization if the cured resin
—cyclic aliphatic amines
—latent catalysis
—quantities of diluents used
—incorporation of fillers into resin
—monofunctional flexibilizers
—casting of large or complex shapes
—selective improvement of adhesive characteristics
—heat-curing adhesive formulations
—theory of glass-fiber laminates
—type of glass or cloth and its surface treatment
—properties of the cured laminate
—non-ester containing solution coatings
—heat-convertible curing agents
—use of epoxy resins in production
—optimum batch size
—use of application equipment
—elimination of adverse physiological reactions

Technical facts and working data in these 12 chapters

1. Epoxy Resins—Their Synthesis and Characterization
2. Curing of Epoxy Resins
3. Primary Aliphatic Amines and Their Adducts as Curing Agents
4. Amines (Continued), Amides, and Latent Curing Agents
5. Organic Acids and Acid Anhydrides as Curing Agents
6. Diluents, Fillers, and Resinous Modifiers
7. Plasticizers and Flexibilizers
8. Casting, Potting, Encapsulation, Sealing, and Lightweight Foams
9. Adhesives
10. Laminates
11. Coatings
12. Handling Methods and Safety Precautions

This book can be purchased from:

PLASTICS TECHNOLOGY

386 Fourth Avenue, New York 16, N.Y.

Why best-selling plastic products of tomorrow begin with Glidden pigments today

In an increasingly competitive market, the top-quality products you produce—and *sell*—must appeal with every color advantage possible.

Colors must be bright and clean. Opacity and hiding power are basic. Uniformity of tone value must be consistent. And colors must be locked in for maximum resistance to fading and bleeding.

Glidden pigments fulfill all of these requirements. Glidden *Zopaque* Titanium Dioxide is the whitest white pigment available. New *Mercadmolith* (mercury-cadmium) and *Cadmolith* (cadmium-selenium) colors offer a combination of advantages found in no other reds and yellows. They are soft, easy to grind; insoluble in all vehicles; high in heat resistance.

Be sure to specify Glidden—a leading supplier of finest pigments to industry.

By the makers of Sunolith Lithopones . . . Euston White Lead . . . Resistox Copper Pigments

THE GLIDDEN COMPANY

Chemicals • Pigments • Metals Division

Baltimore, Maryland • Collinsville, Illinois • Hammond, Indiana • Scranton, Pa.

©19:

vinyl sentinel

QUALITY is worth guarding. Quality materials – like the bright, clear sheeting for this handbag – sell for more. So guard the quality of your vinyls with Argus stabilizers and plasticizers. Argus products are the industry's standard.

Whatever your vinyl formulation problem, Argus can supply you with a stabilizer/plasticizer system to give just the qualities you need – in the mix or in the finished material. Tell us your problem. We'll send appropriate technical bulletins and samples.

Two new Argus stabilizers – Mark WS and Mark C – have just been developed for special calendering operations. Ask us about them.

ARGUS CHEMICAL CORPORATION / New York and Cleveland

Main Office: 633 Court Street, Brooklyn 31, N. Y. Branch: Frederick Building, Cleveland 15, Ohio

Rep's.: H. M. Royal, Inc., 4814 Loma Vista Ave., Los Angeles; Philipp Bros. Chemicals, Inc., 10 High St., Boston; H. L. Blachford, Ltd., 977 Aqueduct St., Montreal.

TAKE A CLOSE LOOK AT THE FULL LINE OF RCI

PLYOPHEN

PHENOLIC RESINS

● When your production calls for phenolics, be sure you call Reichhold—where a full line of RCI PLYOPHENS is available for your bonding, laminating, impregnating or casting requirements ● RCI offers you more than 40 individual PLYOPHENS—including both liquids and powders ● For full information on how RCI PLYOPHENS can best serve your individual needs, clip and mail the check list below. Technical information will be sent to you promptly.

My Name is_____

I am_____
(TITLE)

of the company indicated on this letterhead.

Please send me full technical information on the use of RCI PLYOPHEN Phenolic Resins for:

- ☐ Brake Linings
- ☐ Resinoid Grinding Wheels
- ☐ Wood Waste Molding
- ☐ Decorative Laminate Core Stock
- ☐ Casting
- ☐ Hot Punching Stock
- ☐ Cold Punching Stock
- ☐ Gear Stock
- ☐ Rolled Tubing
- ☐ Insulation Bonding
- ☐ Plastic Faced Plywood
- ☐ Shell Molds
- ☐ Shell Cores
- ☐ Surface Coating

REICHHOLD

Synthetic Resins • Chemical Colors • Industrial Adhesives
Phenol • Formaldehyde • Glycerine • Phthalic Anhydride
Maleic Anhydride • Sebacic Acid • Sodium Sulfite • Pentaerythritol
Pentachlorophenol • Sulfuric Acid

REICHHOLD CHEMICALS, INC.,
RCI BUILDING, WHITE PLAINS, N.Y.

Creative Chemistry... Your Partner In Progress

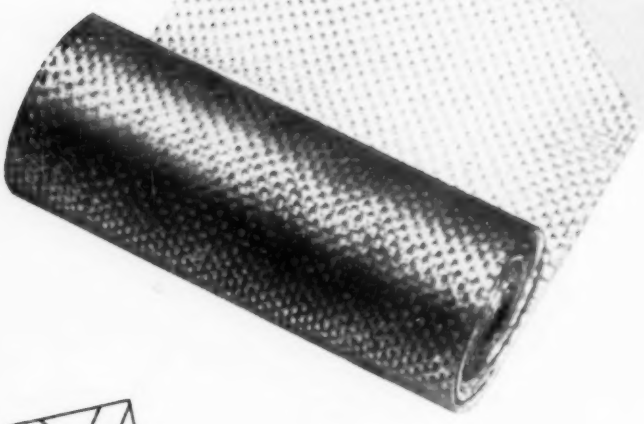
RCI

send for technical data on

IMPREGNATED GLASS FABRICS FOR HIGH TEMPERATURE APPLICATIONS 60° F TO 10,000° F

Trevarno Silicone (F-130), Epoxy (F-160) and Phenolic (F-120) materials have been tested and proved for high-temperature, high-strength missile and aircraft applications. They give optimum heat resistance and strength performance in addition to exceptional electrical and mechanical properties. Chopped high temperature material is available for molded parts for performance at 4,000°F.

In addition to high-temperature, high-strength products, Trevarno glass fabrics are available impregnated with Polyester (F-58), Phenolic (F-92) and Epoxy (F-150) resin systems for general, all-purpose molding. Custom materials can also be developed with fabric weight, weave, thickness and impregnation to suit your individual specifications.



SEND COUPON FOR DATA ON IMPREGNATED MATERIALS TO SUIT YOUR NEED

Trevarno
GLASS FABRICS

COAST MANUFACTURING AND SUPPLY COMPANY
P. O. Box 71, Livermore, California

Please send me data on materials for the temperature ranges or resin systems I have checked below:

- ☐ 60°F to 160°F
- ☐ 160°F to 750°F
- ☐ 800°F to 1500°F
- ☐ 1500°F to 10,000°F
- ☐ Phenolic
- ☐ Epoxy
- ☐ Silicone
- ☐ Polyester
- ☐ Fabric
- ☐ Chopped Fabric

Name _____

Company _____

Address _____

City _____ State _____

4065

NEWS in BRIEF

Continued growth for American business during the next 10 years was predicted by J. A. Hoban, v-p for marketing, B. F. Goodrich Co. "Our present growth trends indicate that our country's productive ability will grow....to more than $600-million annually by 1967," he declared. Up-turns in consumer spending will come by mid-1958 as the result of sizable increases in personal savings in 1957, Hoban predicted. He also prophesied an increase of 6% over 1957 in the rubber and plastics industries.

A basic research institute is needed by the plastics industry, says J. L. Formo, director of plastics research for Minneapolis-Honeywell Regulator Co. (see Guest Editorial, pages 45, 59). The SPE is working on plans for a plastics institute to accomplish the three-fold goals of research, education, and dissemination of information upon which the Society is dedicated.

Business developments in the plastics industry were varied in nature. Two prominent manufacturers of protective clothing, work gloves, and foul weather gear, Jomac, Inc., of Philadelphia, Pa., and James North & Sons, Ltd., of Great Britain, joined forces in the formation of two new firms; Jomac-North, Inc., in this country, and North-Jomac, Ltd., in England. Plasti-Skill, a new company, has been formed for the custom casting of polyesters and epoxies. Monsanto has purchased half the stock of Plax Corp. from Owens-Illinois Glass Co.; the remaining stock continues with Emhart Mfg. Co. Haveg Industries, Inc., has bought Reinhold Engineering & Plastics, and will operate it as a wholly owned subsidiary. A new firm, Ultra Ray Pearl Essence Corp., has entered the pearl essence field as a supplier.

Company expansions in plastics continue in full bloom. Alpha Chemical & Plastics, Newark, N. J., has enlarged its storage facilities and expects to increase its production of reprocessed vinyl and polyethylene. Borden has completed a new office and lab building in Leominster, Mass., for its chemical division's PVC dept. Dow is building a Zefran textile fiber plant in Lee Hall, Va. Flambeau Plastics is erecting a new plant and offices at Baraboo, Wisc. A pioneer Lab is being built by Owens-Corning Fiberglas near Granville, O., as part of its stepped-up research, product, and process activities. A new methanol terminal at Hampton, S. C., is being built by Reichhold Chemicals. Union Carbide Chemicals is erecting production facilities for its Type VYHH vinyl resins at its Texas City, Tex., plant.

New Materials to be noted (see pages 76-8): isotactic polypropylene resin; secondary vinyl plasticizer; terminating agent for polyesters; cyano-acrylic adhesive; two azo pigments; non-staining antioxidant for polyethylene; saturated base paper for electrical laminates; modified acrylic molding powder; and methallyl acetate monomer.

New Equipment worthy of mention (see pages 79-81): sealing unit for blister-type packages; laboratory mill; dielectric heater for preforms; flash trimming presses; semi-automatic washing machine for spray painting masks; portable hydraulic lift table; and horizontal feed mixer.

Plastics Applications of special interest (see pages 83-5): extruded butyrate tubes; electric shaver with melamine housing; spray gun with molded nylon body; auto battery service kit with molded nylon case; molded acetate-butyrate underwater buzzer (fish lure); molded polyethylene dispensing unit for washers; jet charging unit for pressure tanks has clear, molded butyrate housing; glass-polyester reinforced plastic swimming pool; and opaque, colored safety glass with vinyl layer between two sheets of window glass.

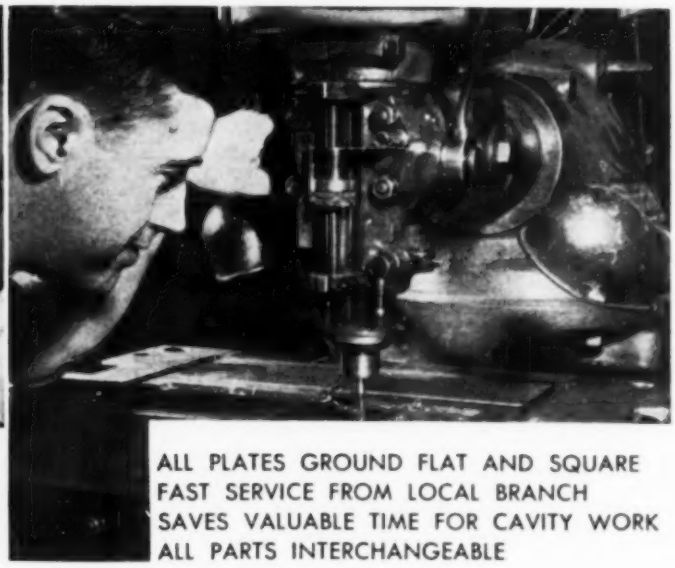
SAVE MORE TIME AND MONEY

WITH DME STANDARD MOLD BASES

You Save on MOLD DESIGNING

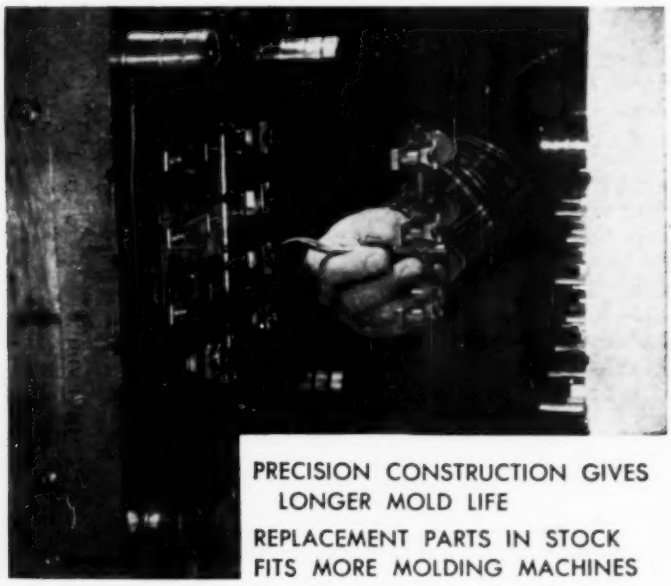
WIDEST RANGE OF STANDARD SIZES
MASTER LAYOUTS SAVE YOU TIME
COMPLETE CATALOG SPECIFICATIONS
EXACT PRICING INFORMATION

You Save on MOLD CONSTRUCTION



ALL PLATES GROUND FLAT AND SQUARE
FAST SERVICE FROM LOCAL BRANCH
SAVES VALUABLE TIME FOR CAVITY WORK
ALL PARTS INTERCHANGEABLE

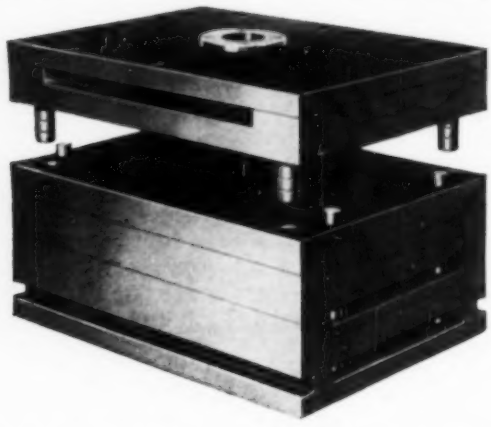
You Save on MOLD OPERATION



PRECISION CONSTRUCTION GIVES LONGER MOLD LIFE
REPLACEMENT PARTS IN STOCK
FITS MORE MOLDING MACHINES

Specify DME . . .

AND START SAVING NOW!



31 STANDARD SIZES – UP TO 23 3/4" x 35 1/2"

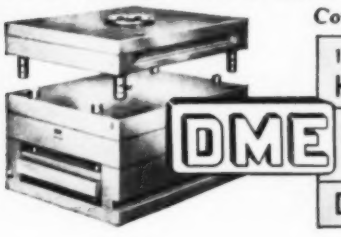
MANY SIZES IN STOCK AT 7 BRANCHES

DETROIT MOLD ENGINEERING CO.

6686 E. McNICHOLS ROAD — DETROIT 12, MICHIGAN — TWinbrook 1-1300

Write Today . . .

For D-M-E's 170 Page **CATALOG** of **STANDARD MOLD BASES** and **MOLDMAKERS' SUPPLIES**



Contact Your Nearest Branch FOR FASTER DELIVERIES!

1217 CENTRAL AVE. HILLSIDE, N. J.	5001 W. DIVISION ST. CHICAGO, ILL.	3700 S. MAIN ST. LOS ANGELES, CAL.
D-M-E CORP.	502 BROOKPARK RD. CLEVELAND, O.	550 LEO STREET DAYTON, O.
D-M-E OF CANADA	156 NORSEMAN AVE.	TORONTO, ONT.

FIRST TIME EVER!

Another

CYCOLAC®

HIGH IMPACT THERMOPLASTIC RESIN

ACHIEVEMENT

TRANSISTOR RADIO CASE CONTINUOUSLY EXTRUDED

PROVIDES FASTER PRODUCTION, EASIER ASSEMBLY, *LOWER MANUFACTURING COSTS...*

Only CYCOLAC measured up to all requirements for the first extruded transistor cabinets ever made! Imagination and engineering provided savings of 87% on dies and engineering costs alone. CYCOLAC also has many other outstanding properties which made this possible. High impact strength, bright glossy colors, light weight, dimensional stability, excellent shock resistance, chemical resistance, and superb electrical properties. Moving smoothly off the production line, extruded profiles are cut to width, speaker openings die-stamped, units inverted, cemented and presto! . . . cases are complete! To add to your profit picture, find out how CYCOLAC can help *you* make more attractive, better products and *save* money!

* **Extruded transistor radio cabinets used in Knight-Kits produced by Custom Plastics, Inc., for Knight Electronics Division of Allied Radio Corp., Chicago, Ill.**

Write Today for Technical Literature

PACESETTER IN

Marbon CHEMICAL

SYNTHETIC RESINS

Division of BORG WARNER • Gary, Indiana

also represented by:

WEST COAST: Harwick Standard Chemical Co., Los Angeles, Cal.
CANADA: Dillons Chemical Co. Ltd., Montreal & Toronto
EXPORT: British Anchor Chemical Corp., New York

BW ® Marbon

Moppet chooses TITANOX* for hiding power...

... and you will prefer these white pigments—whether your plastic or rubber products are in sheet or other form.

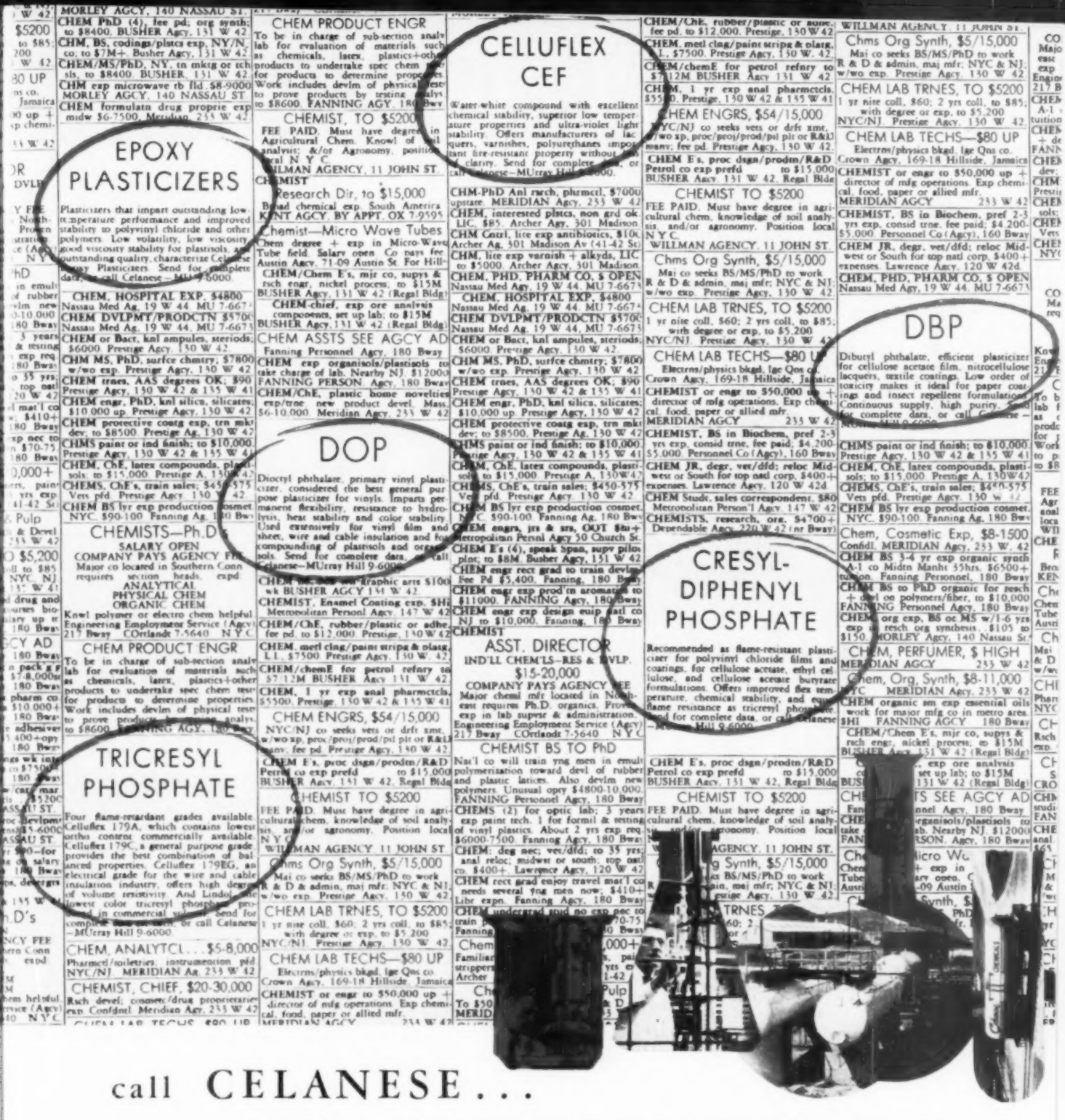
Even with very low pigment content, you can attain remarkable effects in whites and pastels with one or more of these leading white pigments such as TITANOX-RA. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y.; Atlanta 5; Boston 6; Chicago 3; Cleveland 15; Houston 2; Los Angeles 22; Philadelphia 3; Pittsburgh 12; Portland 14, Ore.; San Francisco 7. In Canada: Canadian Titanium Pigments Limited, Montreal 2; Toronto 1; Vancouver 2.

TITANIUM PIGMENT CORPORATION

Subsidiary of NATIONAL LEAD COMPANY

4790

*TITANOX is a registered trademark for the full line of titanium pigments offered by Titanium Pigment Corporation.



call CELANESE . . .

Plasticizers: experienced, excellent character, salary reasonable

When industry has to "hire" a plasticizer, it calls Celanese. This has proved to be the most efficient way to obtain plasticizers with the right application experience . . . with the right chemical characteristics . . . and at the right price.

Reason for this is Celanese research—a continuing program to develop plasticizers of greater service for industry. For instance: this program has already produced four grades of flame-resistant Tricresyl Phosphate—four practical means for building fire resistance into a wide range of consumer and industrial products.

Research to develop plasticizers that satisfy specific needs . . . producing these in commercial volume to assure supply and economical cost . . . this is another example of Celanese filling the critical job requirements of industry.

Celanese Corporation of America, Chemical Division, Dept. 546-A, 180 Madison Avenue, New York 16, N. Y.

Celanese® Celluflex®

Basic reasons . . . . . for improved products

Acids	Functional Fluids	Polyols
Alcohols	Gasoline Additives	Plasticizers
Aldehydes	Glycols	Salts
Anhydrides	Ketones	Solvents
Esters	Oxides	Vinyl Monomers

Agricultural	Paper
Automotive	Pharmaceutical
Aviation	Plastics
Building	Surface Coatings
Electrical	Textiles

Celanese CHEMICALS

Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16

IT'S HERE! AMERICA'S F

pro-

NOW IN C

The world's largest commercial plant to produce polypropylene is now on stream. Pro-fax, Hercules polypropylene, is the most significant new plastic to be developed in years. It has a lower specific gravity than any other plastic material commercially available. Pro-fax has higher tensile strength, hardness, heat resistance, stiffness, resilience and clarity, coupled with the inertness and water resistance typical of a hydrocarbon polymer. Pro-fax is exceptionally easy to mold, yielding parts with a hard, glossy surface available in a broad range of colors.

Among the other important properties of Pro-fax are excellent resistance to grease and oil, water, and many common acids; outstanding electrical properties; and higher impact strength. Altogether, Pro-fax combines more desirable properties than any other plastic now marketed.

There's sure to be a place for Pro-fax in your picture. For further information on properties and uses, call or write Hercules.

NOW THERE ARE TWO

Pro-fax is the Hercules trademark for polypropylene, a hydrocarbon polymer, based on propylene and a new Hercules process. Pro-fax will complement the usefulness of Hi-fax®, Hercules high-density polyethylene, greatly broadening the available markets for plastics, especially those now served by wood and metal.

Pro-fax is the second of many new polymers resulting from a Hercules research program designed to explore the chemical horizons opened by the development of organometallic catalysis systems. Others will follow as Hercules continues its leadership in the important field of polyolefin chemistry.

Cellulose Products Department

HERCULES POWDER COMPANY

900 Market Street, Wilmington 99, Delaware

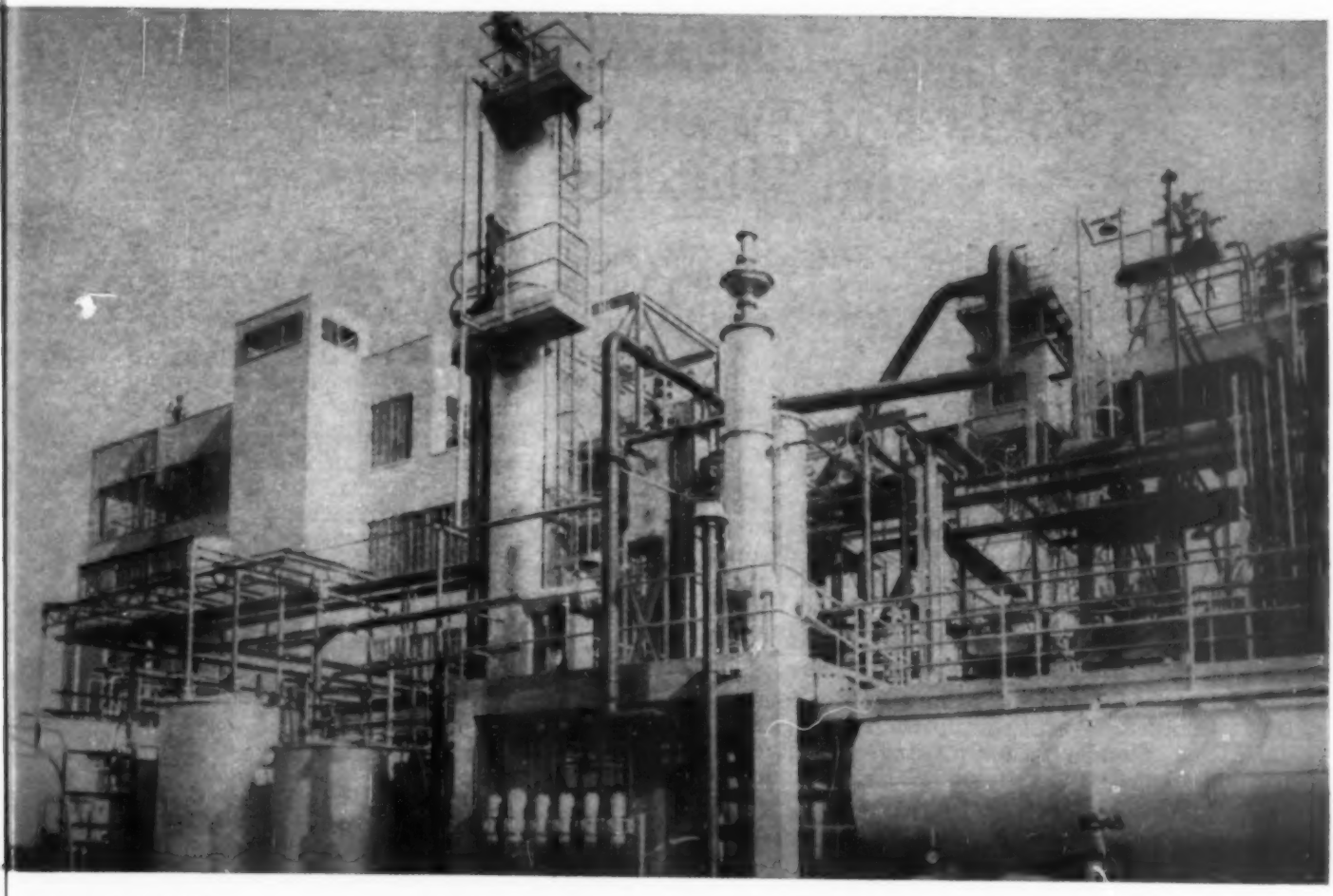
CP58-1

FIRST POLYPROPYLENE

fax

HERCULES TRADEMARK

COMMERCIAL PRODUCTION



Strip away heat, light and staining problems ...stabilize plastisols and organosols with "Dutch Boy"

The "Dutch Boy" sees to it that the stabilization of plastisols and organosols is no problem today . . . despite the sensitivity of dispersion resins.

Take "clears"...

You have four "Dutch Boy" Stabilizers for clear plastisols and organosols.

"Dutch Boy" Provinite* handles high processing or service temperatures. A new, economical "Dutch Boy" barium-cadmium complex, Flomax*, stabilizes stocks where maximum clarity is demanded. Also promotes deaeration in plastisols. CS-137 provides *top notch* anti-oxidant action and light stability in organosols and vinyl solution coatings. The new "Dutch Boy" co-stabilizer, Nalzin*, prevents sulfide staining.

Take brightly colored and outdoor stocks...

"Dutch Boy" Dyphos® is the stabilizer to use. It's unequalled for heat stabilization during fusing cycles. Wonderful for awning cloths, convertible tops, outdoor toys, where maximum weather resistance is important.

Take translucent or highly plasticized stocks...

Try "Dutch Boy" Plumb-O-Sil® C. It gives minimum tinting and reactivity, excellent heat stability and economy. Promotes dry surfaces.

Take opaques, injection and slush molded...

"Dutch Boy" Tribase and DS-207® team up to improve molded stocks. The Tribase steps up heat stability. DS-207 aids mold release.

Get details and technical assistance on these "Dutch Boy" Chemicals . . . and on a new "Dutch Boy" Gelling Agent, BENTONE® 38 that controls flow properties and pigment suspension in these formulations. Write today for new "Dutch Boy" Stabilizer Handbook.

Dutch Boy® CHEMICALS

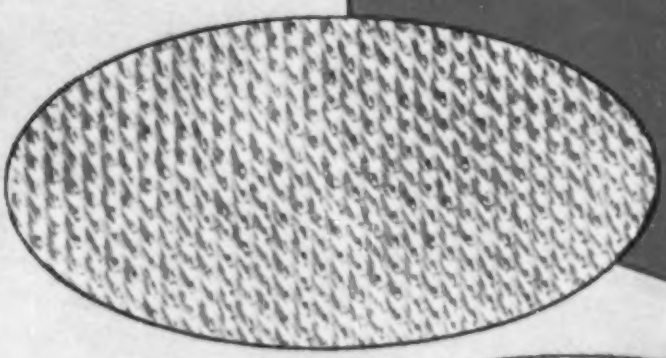
*Trademark

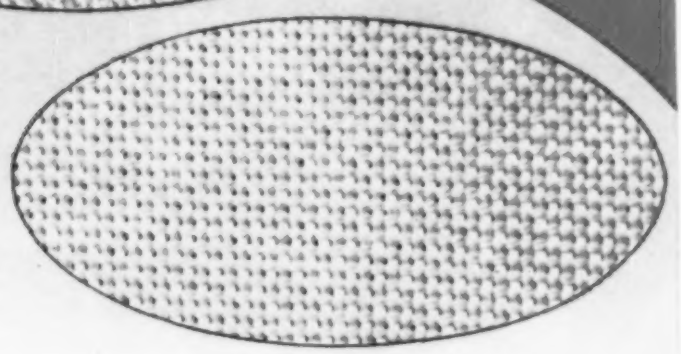
NATIONAL LEAD COMPANY
111 Broadway, New York 6, N. Y.

In Canada: CANADIAN TITANIUM PIGMENTS LIMITED
630 Dorchester Street, West, Montreal

FLIGHTEX GLASS CLOTH

for the reinforcement of PLASTICS





Wherever you need maximum strength per pound of reinforcement . . . high standards of quality . . . uniformity in weight, weave and thickness . . . contact FLIGHTEX for fast service.

Our research laboratories and development facilities are ready to help find the exact fabrics to meet your particular needs.

Write, wire or call for fast service. Get to know FLIGHTEX—you'll like our way of doing business.

Write for our Specification Guide.

FLIGHTEX FABRICS, INC.

93 Worth St. New York 13, N. Y.

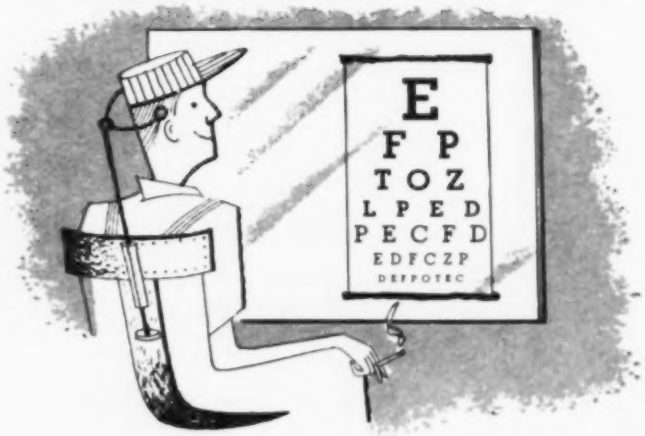
Thermolite 112*

*Patent Applied for

A New Concept In Barium-Cadmium Stabilization

... optical clarity!

Never before has there been a closer approach to absolute optical clarity by a barium-cadmium system that also delivers excellent heat and light stability—superior heat sealing and printability characteristics.



freedom from "PLATE OUT"

Unique chemical structure of Thermolite® 112 eliminates "plate out" on calender rolls in most cases. Specific recommendations available.

■ Thermolite 112—an entirely new type of barium-cadmium stabilizer for polyvinyl chloride film, sheeting, extrusions and dispersions—*is completely free from fatty acids and octoates.* Its powerful action enables you to use small quantities—effect large savings . . . Still further reductions in cost can be attained in certain applications by substituting Thermolite 166, a zinc stabilizer, for part of the barium-cadmium. Both are liquid and can be added directly to the plasticizer, thereby eliminating costly grinding or pre-blending.

Write for more facts on Thermolite 112, Thermolite 166 and the entire line of Thermolite organotin, barium-cadmium, liquid-zinc, and organic heat and light stabilizers.

TIN & TIN CHEMICALS
CERAMIC MATERIALS
ORGANIC COATINGS
WELDING SUPPLIES
PLATING MATERIALS
METALS AND ALLOYS
HEAVY MELTING SCRAP

Stabilizers For All Purposes

METAL & THERMIT CORPORATION

GENERAL OFFICES: RAHWAY, NEW JERSEY

METAL & THERMIT—UNITED CHROMIUM OF CANADA, LIMITED • REXDALE, ONT.

GERING—first choice for quality products at definite savings

Ready measured for one-step in-plant blending... without error!

DRYCOL

Thoroughly Compounded DRY COLORANT for All Thermoplastics

Take a real short-cut to savings with DRYCOL—the one and only dry coloring agent thoroughly formulated for specific end-color use!

Every pack of prime quality DRYCOL comes to you pre-weighed for easy, exact blending with either 50 or 100 pound quantities of any plastic. With no batches to measure, there's never any chance for error, never any spoilage hazards.

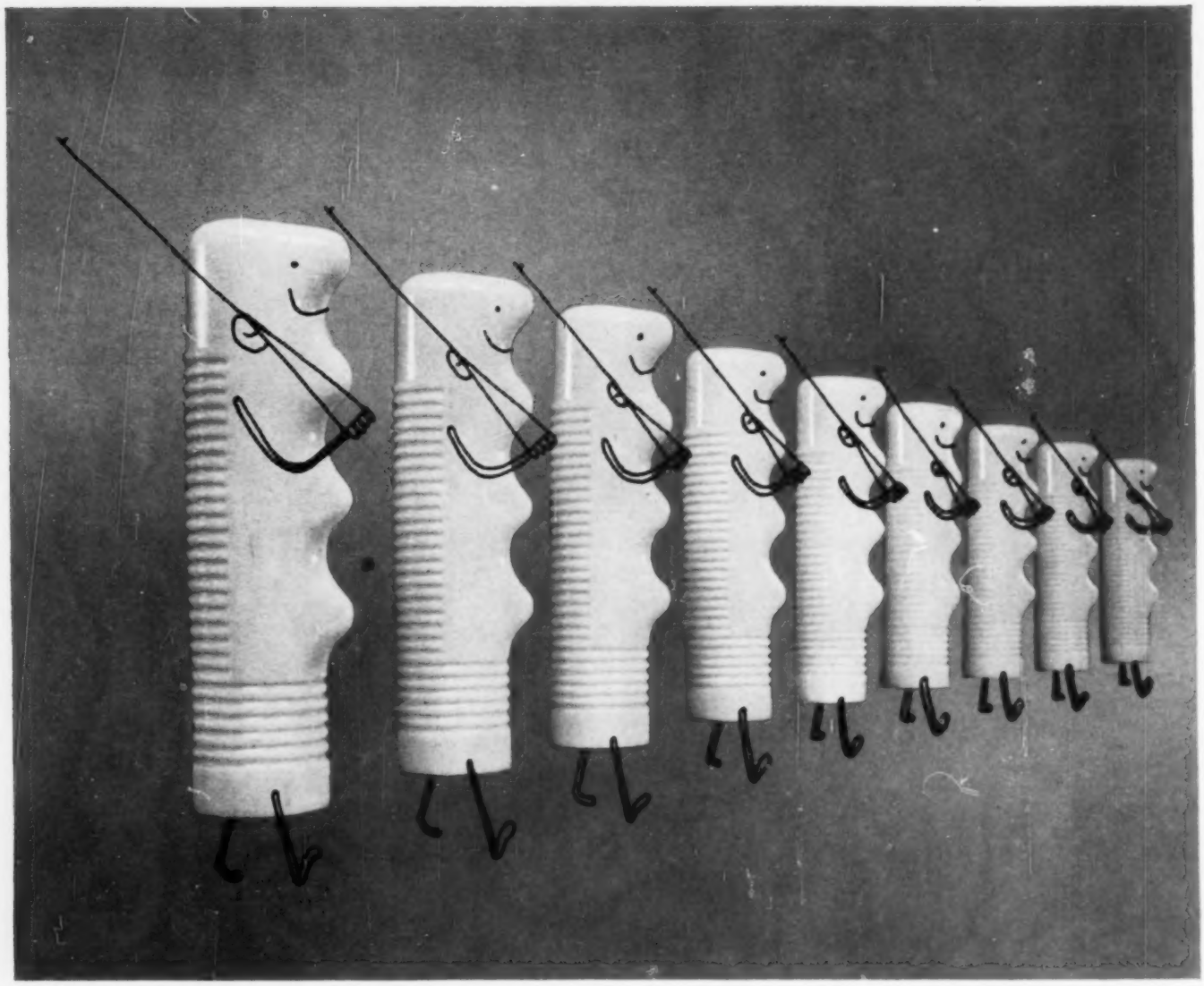
Best of all, DRYCOL lets you have colors galore without having to store! And no top-heavy inventory of colors means you can also get the volume discounts that go with buying bulk orders of natural plastics.

Write for the full story about Gering's easy-to-work-with DRYCOL.

GERING

Colorants

Gering Products, Inc., North 7th St. & Monroe Ave., Kenilworth, N.J. • Sales Offices: 5143 Diversey Ave., Chicago 39, Ill. • 424 Chevy Chase Rd., Mansfield, Ohio



Handlebar grips made from Diamond PVC by Hunt-Wilde Corp., Dayton, Ohio.

A word about DIAMOND PVC resin

UNIFORMITY

Before DIAMOND PVC leaves our new plant at Houston, more than 400 indicating, controlling and recording devices have checked its quality and uniformity.

DIAMOND's investment in quality control instruments is twice the average investment for instrumentation in chemical plants. We watch and regulate every production step—raw materials to resin to bagging.

Other advantages of DIAMOND PVC resin—flow, blending, speed, clarity—spell easier processability and a more uniform product—like the DIAMOND-PVC moldings above.

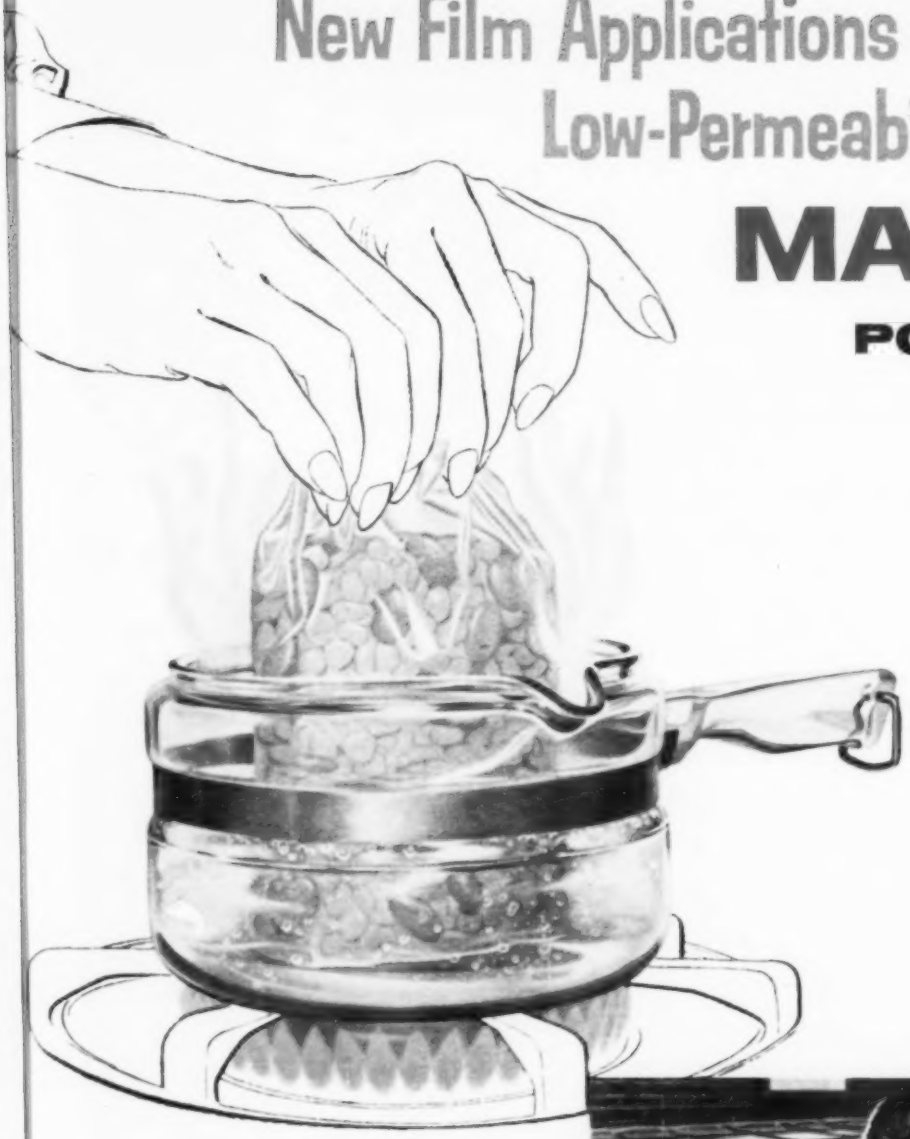
For information on DIAMOND PVC and technical help on processing problems, call your DIAMOND Sales Office, or write DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 14, Ohio.

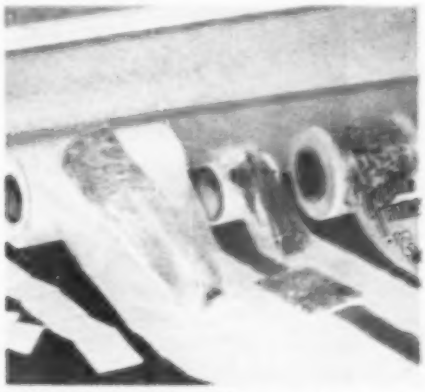
Diamond Chemicals

New Film Applications with Low-Permeability, Heat-Resistant

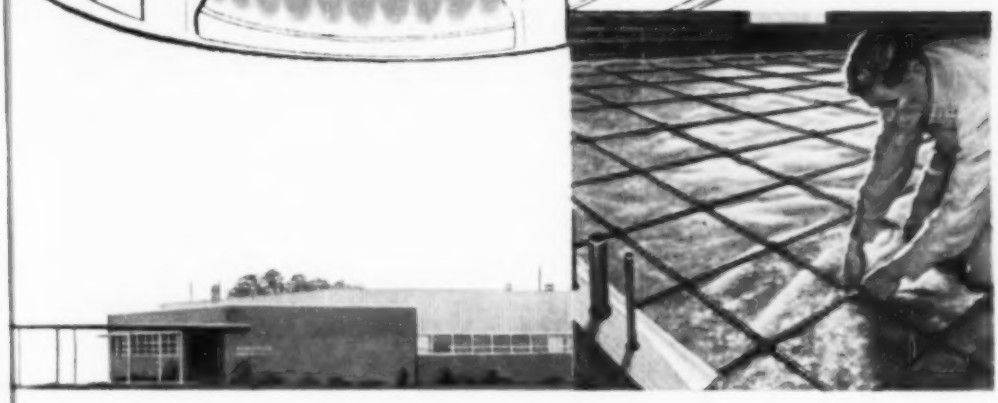
MARLEX* 50

POLYETHYLENE



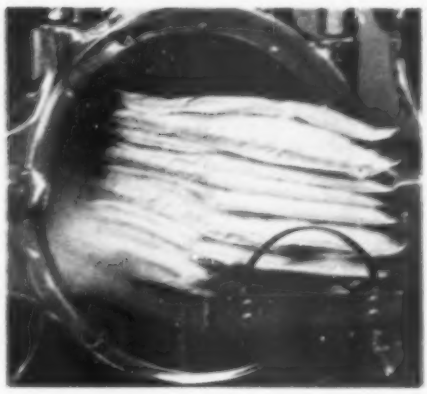


Liquid-tight pouches made from MARLEX 50 film are ideal for packaging foods or industrial products that are oily, wet, frozen or hygroscopic. Foods can be boiled in flavor-sealed MARLEX 50 packages. MARLEX 50 film is impermeable to moisture and most chemicals, and new extrusion techniques yield film with the burst strength and clarity of conventional polyethylene film.



New Sales Service Lab at Bartlesville is completely equipped with latest commercial processing machinery and research apparatus, including environmental test chambers. Phillips experienced technical service staff will assist you in developing new products and processes using MARLEX plastics. Please make arrangements through your local MARLEX sales representative.

High strength and resistance to heat, cold and moisture adapt MARLEX 50 film to many industrial and agricultural services . . . for moisture barriers in building and highway construction, garment bags, drum and carton liners, protective and insulating tapes, high-altitude balloons . . . pond liners, irrigation ditches, mulch, greenhouses, silo caps and liners, protective covers, etc.



Sterilizable MARLEX 50 film is suitable for packaging drugs, medical supplies and instruments . . . covering operating tables . . . and many other hospital uses. Controlled orientation in processing yields a tough, clear, heat-shrinkable film. Excellent stiffness and slip and non-blocking characteristics make MARLEX 50 ideal for use in high-speed packaging applications.

*MARLEX is a trademark for Phillips family of olefin polymers.

PLASTICS SALES DIVISION, PHILLIPS CHEMICAL COMPANY

A Subsidiary of Phillips Petroleum Company, Bartlesville, Oklahoma

DISTRICT OFFICES

NEW ENGLAND	NEW YORK	AKRON	CHICAGO	WESTERN	SOUTHERN & FOREIGN
322 Waterman Avenue, East Providence 14, R. I. GEneva 4-7600	80 Broadway, Suite 4300 New York 5, N. Y. Digby 4-3480	318 Water Street, Akron 8, Ohio FRanklin 6-4126	111 S. York Street, Elmhurst, Ill. TErrace 4-6600	330 Security Bldg., Pasadena, Calif. RYan 1-6997	Adams Building, Bartlesville, Oklahoma Bartlesville 6600, Ext. 8108

"...Like Some Watcher of the Skies"

we find new planets swimming constantly into our ken! John Keats, the poet, voices the sense of industrial exploration which alone can chart new achievement in the complex plastics firmament we are privileged to serve. The joy of discovery is matched only by the kinship and loyalty which turns each new performance discovery into improved quality on the manufacturing and processing line of America's leaders in plastics. The W.E.I. trend is "on the move" worldwide, too!

W. E. I. design makes it possible to transform the "Outer Space" of plastics compounding-extruding into bold new advances... economically sound and profitable!

From a searching "satellite" pilot machine to a solar giant with a 50,000 pound rate each time the earth turns, the complete Welding Engineer line of compounder-extractor-extruders is custom-fitted to proven performance specifications. Arrange today for a confidential conference: WELDING ENGINEERS, INC., Norristown, Pennsylvania.

Dual Worm

WELDING ENGINEERS EQUIPMENT

IS IN AN EXPERIENCE CLASS BY ITSELF!

Specialists in the development and manufacture of continuous operation Dual Worm Compounder-Extruders • Dual Worm Devolatilizers • Dual Worm Rubber Extrusion Dryers • Single Worm Extruders • Send for Catalog No. 663.

PLASTICS TECHNOLOGY

Mold Design Technology for Polyethylene

Part design and mold components, rigidity, and temperature control can be tailored to fit the special needs of polyethylene injection molding.

R. W. VANSICKLE, *Manager*
Plastics Technical Service—South
The Dow Chemical Co.
Freeport, Texas

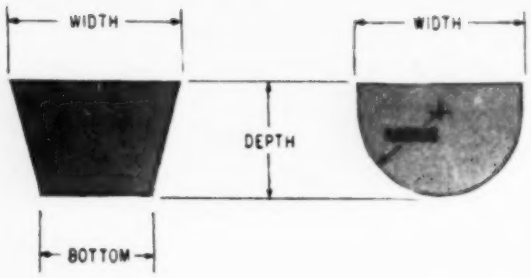
POLYETHYLENE has become a large-volume injection molding material during the past three years. Estimates generally agree that the present annual usage of polyethylene for injection molding is about 17-20% of the current 600-million pounds annual total production of this plastic.

Experience in design, construction, and operation of injection molds for polyethylene has shown that a few modifications of the technology for older materials can be recommended to "tailor" molds to fit polyethylene. Some characteristics of polyethylene call for more strict observance of technological principles that have been established for the older plastics, but have been subjected to considerable "backsliding" in practice.

Sprues, runners, gates, mold temperature control, product design, and mold rigidity are topics in which mold design principles, especially applying to polyethylene, are involved. A considerable amount of literature has appeared that has bearing on these topics. Field experience and observations of technical service

Robert William VanSickle was born in Whitehall, Wisc., in 1919. He attended the University of Wisconsin, receiving a B.S. in Chemical Engineering in 1942. Following graduation, he joined Hercules Powder Co. and served successively as research engineer (1942-43), and nitrocellulose shift supervisor (1943-45). He went with Dow Chemical Co. in 1945, serving as cellulose products development engineer in 1945-47, and as plastics engineer for the company's Plastics Technical Service from 1947-1956. In 1956, he was promoted to his present position as manager, Plastics Technical Service—South. His technical society memberships include SPE and A.C.S. Mr. & Mrs. VanSickle have three children (two boys and a girl), and reside currently at Lake Jackson, Tex.

Based on a paper presented at the 132nd meeting, American Chemical Society, New York, N. Y., Sept. 10, 1957.



DEPTH : $\frac{2}{3}$ x WIDTH

BOTTOM : $\frac{3}{4}$ x WIDTH

DEPTH : $1\frac{1}{4}$ x RADIUS

Fig. 1. Runner cross-sections for polyethylene injection molding.

engineers, colleagues of the author, have been summarized to augment laboratory data and bibliographical sources.

Sprues, Runners, Gates

General experience in the plastics molding industry indicates that the size of sprues and runners is not critical for ordinary molding operations. Some factors of size are important, however, especially when cooling and mold-filling are concerned.

Large sprues and runners, greater than $\frac{3}{16}$-inch in diameter, require up to twice as much cooling time as the molded part requires. Overlarge sprues may result in unnecessary cycle time, not required for the molded part, to prevent breaking the sprue when the mold opens. Large sprues and runners often result in requiring the mold surfaces to be operated at a temperature more satisfactory for cooling the sprues and runners than is needed to make a satisfactory molded part. Both of these factors may be emphasized by considering whether the molding operation is intended to mold sprues and runners or to mold finished parts.

Runners of circular cross-section have been accepted generally as providing maximum flow area with minimum surface area to chill the plastic. Polyethylene has high specific heat and low thermal conductivity, and it should have runners shaped to assist chilling, rather than to prevent it. Runners of the forms shown in Figure 1 have been found to be satisfactory for injection molding polyethylene.

Small sprues, runners, and gates can interfere with the proper rate of mold filling. A tabulation of runner and sprue sizes, made by measurement of articles molded in commercial practice, is given in Table 1.

Most of these articles have been molded with a minimum amount of difficulty that could be attributed to the size of sprues and runners. It may be summarized to say the sprues should be approximately $\frac{3}{16}$-inch and probably not greater than $\frac{1}{4}$-inch in diameter. The runners should be kept to $\frac{3}{16}$-inch nominal width whenever possible, and cross-runners can be smaller down to about $\frac{3}{32}$-inch width as a minimum recommendation.

Gates are more critical with respect to size than are the sprues and runners. The gate should be large enough to: (1) Allow the mold to fill as quickly as the molding machine can supply the plastic; (2) Allow the passage of this much plastic at a low enough velocity to prevent over-heating the material or burning the mold metal at the gate; and (3) allow passage of plastic at low enough velocity to avoid jetting.

Figure 2 shows jetting of polyethylene into a mold. Polyethylene seems to be more critical in this respect than the older plastic materials. It seems to jet more readily, and the ribbon of material that forms the jet is not remelted readily into the main body of plastic. This results in a surface defect that is extremely obvious and difficult to eliminate by mold temperature increase.

If the fill time for the mold is too long, sink marks may occur because an insufficient mass of plastic is placed in the mold before the material becomes too stiff to allow sufficient flow. Surface defects can be caused by having a gate that is too small, thus increasing the time for mold-filling. Warping and cracking also may occur more readily if the gate is too small, because extremely non-uniform pressure distribution occurs in the mold cavity.

No one has been successful in computing the ideal gate size for polyethylene injection molding, and experience must remain the best teacher. Some satisfactory empirical gate-size determinations have been established, and these size ranges can be used as a guide. Table 2 gives a system of gate size recommendations based on the gate thickness in relation to the thickness of the molded parts that the gate feeds.

Gate lands have been used successfully to control the rate of filling in multiple cavity molds, and they are an important factor in mold operation. The gate

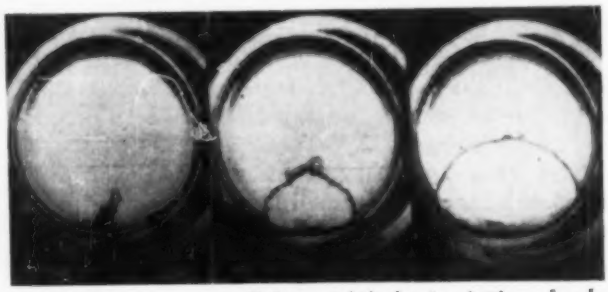


Fig. 2. Photo sequence (left to right) showing jetting of polyethylene during injection molding process.

Table 1. Size Variations in Runners and Sprues for Commercially-Molded Polyethylene Products.

Part	No. of Cavities	Machine Size, Oz.	Shot Weight, Oz.	Runner		Sprue
				Shape	Size, In.	Dia., In.
Shaker Body	12	8	4.8	Round	3/16	1/4
Container Lid	8	12	3.6	Half-Round	3/16 & 1/8	7/32
Vial Top	24	10	6.3	Round	3/16 & 3/32	5/16
Toy	8	4	2.4	Trapezoid	5/32 & 1/8	3/16
Dish	2	16	10	Round	1/4	9/32

land has been defined as the restricted portion of the runner immediately adjacent to the mold cavity.

Mold Temperature Control

Mold temperature control is a necessary tool for the injection molding of polyethylene. It is essential that the entire surface of the mold cavity be maintained at a uniform temperature.

Uniform temperature of the mold requires location of the heat exchange channels in the block of steel which is to have its temperature controlled, and not in the plate behind it (1)*. This requires engineering the channels relative to the location of ejector pins, guide pins, and return pins to provide the maximum number of channels. The heat-exchange channels should be large, preferably ½-inch in diameter or larger. When available space will not permit large channels, however, small ones are better than none. Understandably, small channels restrict flow, reduce the heat-transfer area, and are subject to flow stoppage owing to corrosion or sediment.

In conjunction with extensive channeling in polyethylene molds, it is necessary to use mold temperature control equipment capable of circulating a large volume of fluid through the mold. The heat-exchange fluid can be operated at temperatures within 5-10° F. of the desired mold temperature. Figure 3 illustrates a well cored mold. In this mold, the cavity is properly channeled, and the force section of the mold is cored and baffled for uniform temperature control.

The temperature chosen for the operation of polyethylene molds is dependent upon the particular features the molder considers important in the end-product. The following mold temperature factors must be considered by the molder:

(1) Economy. The greatest productivity usually is obtained by molding in cold molds (50-110° F.) Cold molds provide the most rapid chilling and set-up of the material in the cavity. Cold-temperature mold operation is limited by the temperature of the water and the refrigeration capacity available. An additional limitation is the dew point temperature. Operating molds at temperatures below the dew point causes condensation on the mold surfaces, and they are likely to become rusty.

Adequate gloss and molding appearance can be obtained by using cold molds. It should be recognized, however, that the best physical properties and gloss are not obtained with this method. Operation of low-temperature molds is primarily for reasons of economy and high productivity in applications having only secondary emphasis on quality.

*Numbers in parenthesis refer to bibliography at end of article.

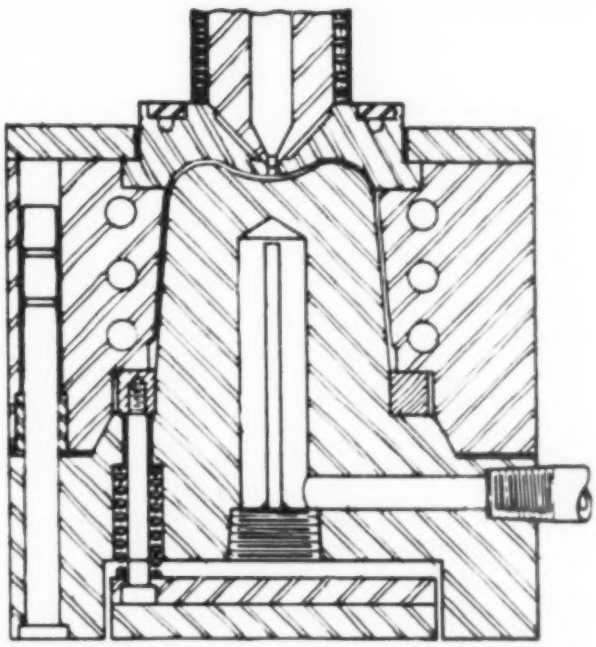


Fig. 3. Single-cavity automatic mold with heat-exchange coring.

(2) Stress crack resistance. Stress-crack resistance is often a mandatory property in finished injection molded articles. Safe practice calls for use of polyethylene of low melt index (grade 2.0 or lower) in such applications, even though it is stiff-flowing and difficult to mold. Warm molds (120-160° F.) are desirable for molding low melt-index polyethylene to obtain the inherent stress-crack resistance and low-temperature flexibility properties of the plastic in the finished article. Other molding conditions such as plunger time, packing, injection pressure, and plastic temperature also must be controlled carefully.

The rate of crystallization of polyethylene is likely to be increased when the mold is warm, because the rate of cooling is slow. Rapid crystallization can result in considerable residual stress in the molding, which reduces the stress-crack resistance. Experience indicates that a cold mold that requires higher injection pressure, and may have higher packing stress, results in a greater loss of stress-crack resistance.

(3) Surface luster. Smooth finish, high gloss parts often are essential to the salability of polyethylene molded parts. Where this is of prime consideration,

Table 2. Range of Satisfactory Gate Sizes for Injection Molded Polyethylene

Gate Size & Shape	Section Thickness of Molded Part, In.			
	0.035-0.060	0.060-0.100	0.100-0.180	0.180-0.250
Round				
Diameter	0.025-0.040	0.035-0.070	0.050-0.090	0.060-0.100
Rectangular				
Thickness	0.025-0.040	0.035-0.070	0.050-0.090	0.060-0.100
Width	0.125-0.188	0.125-0.188	0.125-0.250	0.188-0.312

warm molds should be utilized to promote the high gloss and finish desired (2).

(4) Warpage. Warpage is influenced markedly by pressure distribution through the mold. Warm molds reduce the cooling rate of the molten polymer in the mold, and assist in pressure distribution. The net result is a lower stressed part with reduced tendency to warp.

Molders often are misled by the results of cold molds relative to warpage of molded parts. Cold molds quench or cool the plastic surface, and provide a quick set to the molded part which may appear warp-free on ejection. Cold molds also promote rapid cooling of the plastic in the mold, and a high pressure drop across the mold with non-uniform pressure distribution. This, in turn, promotes packing and flow stresses which are likely to be relieved as the part ages a few hours or days. Relief of the stresses is accomplished partly by cold flow, and partly by distortion or warping.

Cold molds quench or partially super-cool the polyethylene; thereby, inhibiting crystallization of the polymer for periods ranging from hours to weeks after molding. This crystallization is inexorable, however, and as the crystallization progresses towards completion, shrinkage and relief of stresses occurs and warpage is likely to appear. This, in part, accounts for "post warpage" after molding. Conversely, warm molds promote more immediate crystallization, with the result that a part molded warp-free will undergo less change upon aging and most likely will remain unwarped upon storage.

(5) Dimensional control. Polyethylene has high mold shrinkage characteristics (0.020-0.050-inch per inch) as compared with other plastics. This wide range of mold shrinkage makes it difficult to mold polyethylene to close tolerances, and has been a factor in restraining the use of polyethylene in many precision applications.

Mold temperature has more direct effect on polyethylene shrinkage than any of the other molding variables. Utilization of this knowledge with uniform mold temperature control can promote the use of polyethylene in close-tolerance molding applications.

When molding at close tolerances, it would be advisable to build experimental molds to determine cavity size (3). However, time and cost usually preclude such measures for the average molder.

Figure 4 shows the trend and effect of mold temperature control on the shrinkage of polyethylene (4). This graph illustrates the general effect of mold temperature. The data from which this graph was taken shows the trend to be identical for several combinations of varying conditions.

Well-channeled molds and good temperature control equipment make it possible that a mold designed for low shrinkage (0.020-inch per inch) can be controlled to close tolerance. Designing with low shrinkage allowance should produce parts on the large or maximum side of specification. Careful increase of mold temperature to increase shrinkage should enable the molder to approach and reach the proper dimensional specificaton and tolerance.

From the above discussion, it should be apparent that the control of product quality must begin in the design and construction of the mold. Molds must be well cored or channeled to provide uniform mold temperature. The temperature of the mold should be uniform within a maximum limit of 5° F. Greater variation than this can make it difficult to control the factors discussed above (5).

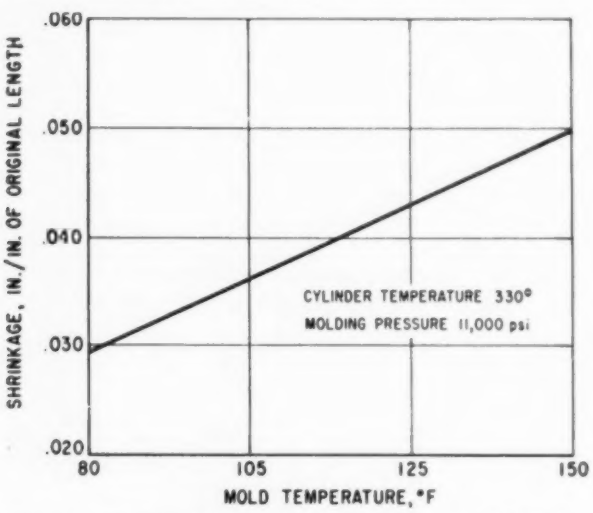


Fig. 4. Effect of mold temperature on shrinkage of polyethylene.

Part Design

In the design of a polyethylene item, engineering properties and appearance are primary considerations. The effect of the product design on the molding operation also is important from a cost standpoint. This latter consideration often is treated lightly, even neglected (1).

Section thickness and variations of section thickness determine the manner in which polyethylene fills the cavity. If one section of a cavity is thinner than an adjacent section, polyethylene will flow more rapidly

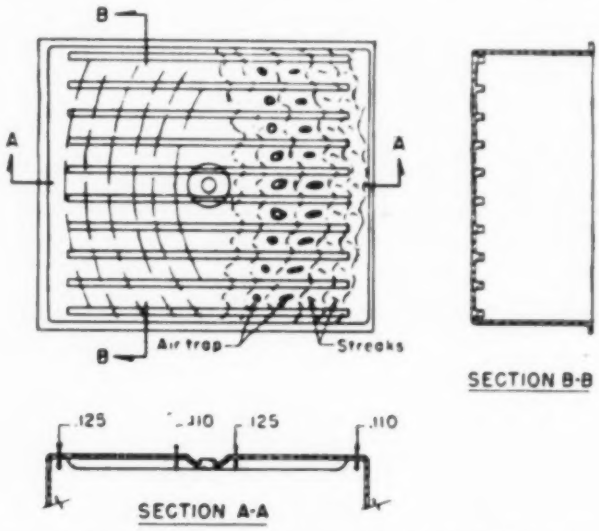


Fig. 5. Sectional view of flow patterns in a polyethylene refrigerator dish.

into the thick section. Polyethylene is an easy-flow plastic and consequently is more subject to variations in flow with small variations in section thickness.

Air traps and weak welds occur in polyethylene because of the manner in which thick and thin sections affect flow. Welds in polyethylene are weak and subject to fracture and cracking when weathered or exposed to soaps, detergents, and other household reagents. Figure 5 demonstrates the flow of plastic in a ribbed section, and clearly illustrates the advancing and retarded areas of flow.

Variations in section thickness are commonplace in the design of polyethylene parts. They occur when ribs, flutes, and rolled edges are used to increase the section modulus of polyethylene, which has a low elastic modulus. Flutes and ribs should be designed large enough to enable both sides of the wall section to be match-contoured and a uniform wall thickness maintained throughout in order to eliminate the aforementioned flow variations. The same beneficial stiffening effect of the contour is maintained in so doing. The mold cost is increased, but the net result of customer satisfaction and a healthy, growing market quickly justifies the added cost.

In addition to using contour principles to maintain desired stiffness, consideration must be given to the general section thickness of the part to provide the stiffness required, without allowing for contour design. It is possible to mold polyethylene in sections as thin as 0.025-inch (2). This thin section, however, should be considered only for small parts, and where a high degree of flexibility is desirable. Small containers and houseware items have a functional stiffness in the practical thickness range of 0.045-inch. Items such as medium-size containers and small dishpans should have sections of 0.060-0.080-inch for practical function. Large containers and dishpans, and similar items should have sections in the range of 0.090-0.110-inch. Extra large area molds, such as clothes hampers and trash cans, are satisfactory with a section thickness of 0.115-inch or more. These section thicknesses are for low-density polyethylene, and may be modified for higher-density polyethylene which is more rigid.

The principles of balanced flow in multiple-cavity molding apply to polyethylene as well as to other thermoplastics, and will not be discussed here. Figure 6 is an example of unbalanced flow to eliminate stress cracking. This figure shows a compartmented box and fitted cover with the hinges molded in place. This illustration also is a redesign of the original hinge which was too stiff for satisfactory lid operation. The original design of the box had three thick hinges, with balanced flow to both cavities. In operation, both cavities filled at the same time, and the box produced had a very stiff hinge action. The hinge had a weld line parallel to the line of closure, and located through the center of the hinge where the point of maximum bending stress occurred.

In operation, the hinges stress cracked and severed in a matter of days, and stress cracked in minutes when tested in a stress-cracking test reagent. Redesigning the hinges, eliminating one hinge and reducing each of the other two into four thin and narrow segments, remedied the stiff closing action of the box. Off-balancing the mold by gating the deep compartment with an extremely small gate and gating the shallower lid with a larger gate resulted in the material overflowing from the lid into the bottom section before the bottom was filled completely. Welding then occurred in the side of the main box, and not in the hinges. The net result of this off-balance produced a box with no welds or stress-crack failure in the hinges. This particular illustration is a specialized case, but the principles are not unusual and undoubtedly will have frequent application.

Polyethylene is used extensively in freezer container lids and other similar closures. Warpage is a frequent problem in such applications. Normal design has resulted in lids having thin flat surfaces with a thick rim at the edge. The thin flat portion of the lid cools rapidly after mold filling, and the thermal shrinkage in this section is far advanced. The thicker rim cools more slowly, and its shrinkage occurs after that of the thin portion. Although both portions are connected, the perimeter of the rim becomes smaller than the perimeter of the flat section. This causes a peripheral stress that forces the flat section to buckle. Correct design of uniform section thickness in the entire lid will help reduce this problem.

Mold Rigidity

Molds for polyethylene should be designed to provide maximum rigidity for several important reasons. Precision, physical properties, and economy are affected directly by the rigidity of the mold.

The stiffness of the mold structure and the alignment of the mold cavities are the principal mold rigidity considerations. Steel is the preferred mold material rather than other metals with lower elastic moduli. The thickness of metals surrounding the individual cavity blocks should be not less than one inch to provide a stiff structural component. Even though polyethylene is a relatively soft resin, it is introduced into an injection mold under the rather high pressure of 2,000-5,000

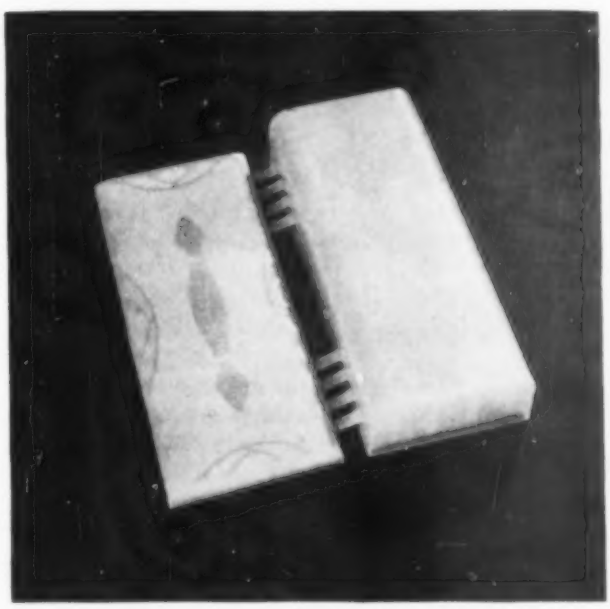


Fig. 6. Compartmented polyethylene box and fitted cover with molded-in hinges.

psi. The internal pressure in the mold can result in high unit stress in the mold wall; as high as 50,000-100,000 psi. This causes mold deformation that can be kept to a minimum by employing massive mold walls (6).

The alignment of mold cores and cavities requires rigid mold construction. Thin wall containers may be used to illustrate the need for precision alignment. Conventional mold construction that depends on guide pins for alignment usually allows approximately 0.008 inch of shift between cavity and force halves of the mold in a direction that is unpredictable in advance.

If a container to be molded wth a wall of 0.035-inch has a mold alignment shift of 0.008-inch, one wall will be 0.045-inch thick and the opposite wall will be 0.027-inch. This difference in wall thickness is sufficient to require excessive injection pressure to fill the cavity. (The pressure requirement corresponds to that needed for an 0.027-inch wall, rather than an 0.035-inch wall.) Furthermore, it is likely that a weld line or an air trap will occur on the thin side because the plastic will fill the thick side first and flow back to the thin side before the air on the thin wall has been pushed out of the mold.

The air trap and its weld line make a spot of low strength and reduced chemical resistance on the molded part. The higher injection pressure tends to use more plastic material than is needed, and make the part heavier. Higher injection pressure usually results in greater residual stress in the part. This, in turn, increases the tendency to warp, reduces both the heat-distortion temperature and the available working stress (7).

Figure 3 illustrates a mold design that employs a taper or cone fit of the force in the cavity to provide greater rigidity. The mold provides considerable improvement in alignment of force and cavity as compared with a conventionally aligned mold employing guide pins. The improvement decreased misalignment from 0.009-inch shift to 0.0025-inch (8).

Conclusion

These notes on mold rigidity, product design, mold temperature control, and mold feed systems have been presented as fundamental considerations to extend existing mold design technology in order to cover some of the special needs for injection molding of polyethylene.

Successful extension of applications of injection molded polyethylene depends as much on advances in fabrication technology and equipment as it does on development of modifications of the plastic itself. Continued study of fabrication is expected to contribute its proper share towards advancement of applications of this mass-production engineering material.

Bibliography

(1) "The Technology of Injection Molding—Fundamental Considerations." Bulletin Plastics Technical Service, Dow Chemical Co., Midland, Mich. (1952).

(2) "Molding Techniques: Mold Design," **Modern Plastics**, 32, 2, 95. (Oct. 1954.)

(3) "Alathon Polyethylene Resin." Bulletin X-19b, Polychemicals Dept., E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. (1955.)

(4) Tessin, M. Q., "The Effect of Molding Conditions on the Physical Properties of Polyethylene." Unpublished report #654-177, Plastics Technical Service, Dow Chemical Co., Midland, Mich. (1954.)

(5) Miller, R. W., and Hughes, F. T., "Mold Shrinkage and Dimensional Stability of Linear Polyethylene," Technical Papers, Society of Plastics Engineers, Inc., Vol. III, pp. 468. (1957.)

(6) Thayer, G. B. "Injection Molding—1956," **Modern Plastics** Encyclopedia, pp. 612. (1956.)

(7) Ziegler, E. E., and Brown, W. E., "Stress Cracking (Crazing) of Polystyrene," **Plastics Technology**, 1, 6, 34; 1, 7 409. (July & Aug. 1955.)

(8) Fe ris, R. N., and Meeks, P. J., "Importance of Mold Rigidity in Injection Molding," **Ibid.**, 3, 5, 371. (May 1957.)

—THE END

Changes in PT Editorial Advisory Board

Three members have left our Editorial Advisory Board, effective with this issue. Because of changes in their duties or expanded work-loads with their firms, Albert A. Kaufman (Prodex Corp.), Adolphe J. DeMatteo (Watson-Stillman Press Div., Farrel-Birmingham Co., Inc.), and D. Lorin Schoene (Naugatuck Chemical Div., United States Rubber Co.) have been forced to resign from our Board after three years of service.

Dr. Schoene is being replaced as a "materials" man on the Board by Robert L. Knapp, manager of Kralastic research and development, for Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn. Born in Keokuk, Iowa, in 1921, Mr. Knapp attended Brown University and received a B.S. in Chemistry in 1943. From 1943-46, he served as an officer with the U.S.A.F. Weather Service. He joined Naugatuck Chemical in 1946 as a research chemist, and became section manager in 1957. In his work, he is an active member of A.C.S. Mr. & Mrs. Knapp and their four children reside currently in Naugatuck, Conn.

C. B. MARTIN, *President*
Resin Fabricators
Toronto, Ont., Canada

Reinforced Epoxy Spray Masks for Two-Tone Painting

The fabrication, utilization, and repair of masks used for two-tone painting of shrouds for out-board motors.

IF all outboard motor covers were dimensionally identical, spray painting them with two different colors would be no problem. But since each cover varies just a fraction, some way had to be found to shield one area of the cover with a mask whose elasticity would compensate for any slight changes in contour, curve, and dimension of the individual cover. For that reason, reinforced epoxy spray painting masks now are used almost exclusively by Outboard Marine Corporation of Canada, Ltd., manufacturers of Johnson, Evinrude, and Elto outboard motors (see Figure 1).

The outboard covers, called "shrouds," are aluminum die castings produced in two halves that later are hinged when assembled on the motors. To improve outboard appearance, design engineers called for multi-colored shrouds; a basic white in combination with blue, black, red, or green (see Figure 2).

Before the castings are painted, they are polished smooth for optimum paint finish. These polishing and finishing operations cause small differences in the shrouds, since workers cannot remove an identical amount of material from each casting. While they may appear to be exactly the same size, each casting varies enough in over-all dimensions to pose a special problem in the design of spray painting masks.

Metal spray masks, most commonly used when the shrouds were painted in a single color, were out of question because their rigidity dictated that each shroud have its own mask. As such, this would have represented an astronomical cost for thousands of individual masks. Metal masks were rejected, also, because of the need for a smooth parting line between the two colors on the shroud to prevent possible over-spray; such over-spray would have required expensive manual removal of the excess paint.

The need for masks that possessed sufficient flexibility for a tight fit to each shroud, regardless of the differences in contours of the shrouds, led Outboard engineers to consider the possibility of a reinforced plastic spray mask that would last the entire production run. Design and production of the masks were turned over to Resin Fabricators, since our firm is experienced in fiberglass-epoxy tooling methods. The results of our work are discussed here.

Fig. 1. Hand-made spray masks of fiberglass-reinforced epoxy used to paint out-board motor shrouds with two-tone color decorations.

Fig. 2. Two-tone painted shrouds for Johnson and Evinrude out-board motors.

Mask Fabrication

The complexity of shroud contour made it impossible to use a resilient solid material in strip form as the effective masking interface. Required for this type of mask was a liquid resin material that could be polymerized in place, such as Epon 828* epoxy resin, catalyzed with diethylenetriamine.

Since the shrouds consist entirely of compound curves, any rigid approach to masking meant that a small variation at one point in the shroud could result in a large gap occurring between the rigid mask and the shroud elsewhere along the painting line. At the masking edge, the point is sprayed with a pressure of about 40 psi. and, consequently, any small gap between the mask and shroud would result in a fuzzy paint line.

Epoxy-fiberglass masks are required to be flexible enough to take up the variations in shroud dimensions, yet rigid enough to allow firm clamping and handling production during production. For this reason, plus the requirement of high solvent resistance, the main body of the mask is made of a slightly flexible Epon epoxy resin-fiberglass construction, and the edges of the mask are a rubber-like modified Epon resin material. Only the edges of the mask touch the shroud (see Figure 3), and the main body of the mask is spaced about 1/8-inch off the shroud surface to allow for variations in contour dimensions of the aluminum die castings.

With these general conditions, Resin Fabricators developed the following broad manufacturing technique.

On a sample shroud, 1/8-inch of pattern maker's wax is laid on the area to be masked. Holes are cut in the wax to allow for 3/8-inch wide resilient edge material and certain location points. Since Epon mixes are excellent adhesives, the shroud first has been coated with a silicone release agent. One-half of the edge area and the location points then are filled, flush with the wax, with the edge material. This material is an Epon paste consisting of 100 parts by weight of Epon 828, 70 parts of Thiokol LP-3 (a thixotropic filler to give a paste consistency), and 10 parts of diethylenetriamine.

*Product of Shell Chemical Corp.

Fig. 3. Second half of a spray mask being placed on a shroud prior to painting.

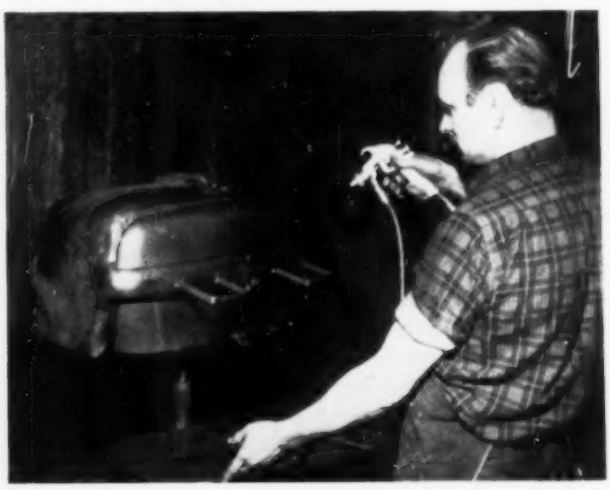


Fig. 4. Spray painting a masked shroud with a pressure of 40 psi.

Over the whole waxed area is laid precut fiberglass cloth that is impregnated with a mix of 100 parts Epon 815, 30 parts Thiokol LP-3, 20 parts inert filler, two parts of thixotropic agent, and 10 parts of diethylenetriamine. The number of layers of cloth used depends on the size of the laminate. At this stage, metal clamping devices usually are molded into the laminate. The laminate then is allowed to gel firmly at room temperature.

The main body of the mask with its partial edges and location points then is taken off the shroud. Following this, the wax is removed from inside the mask, ragged edges of the laminate are trimmed with a band saw, and the mask replaced on the shroud. Finally, the assembly is placed in an oven and the mask cured fully at a temperature of 150° F. After this cure, the mask is in a stable state. The final half of the ⅜-inch wide edge is made by applying the paste edge material that is allowed to cure at room temperature.

The completed mask is tried out under production conditions, and any necessary adjustments are made in the clamps and along the masking edge. At this stage, the mask becomes a production tool.

Application of the Masks

In use, the two halves of the masks are placed on the shroud and locked in place to prevent possible shifting and to ensure a tight seal. The exposed surfaces of the shroud are spray-painted at a pressure of 40 psi. (see Figure 4,) after which the mask is unbolted and removed (see Figure 5.) When not in use, the masks are locked on shrouds so that they will retain their shape.

After each spraying, paint begins to build up along the edges of the mask. Following each seventh use, the masks are soaked for several minutes in a tank of toluol and then are brushed to remove this accumulated paint from the edges (see Figure 6.) Despite the fact that the paint itself contains approximately 50% solvent and the masks are cleaned in solvent, the reinforced epoxy masks have not been affected in any way.

(*Continued on page 59*)

Fig. 6. Solvent cleaning of accumulated paint from edges of a reinforced epoxy spray mask.

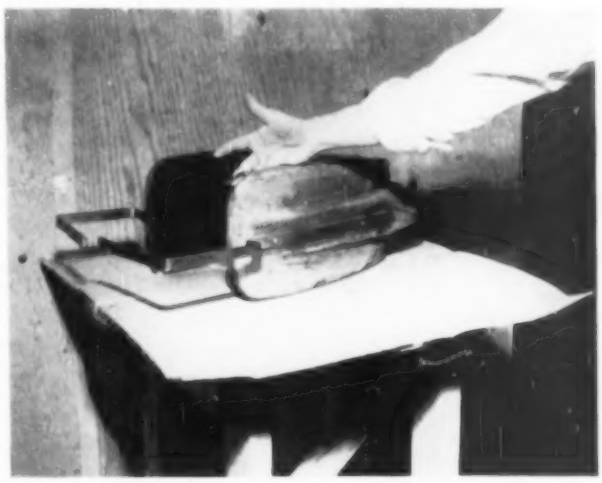
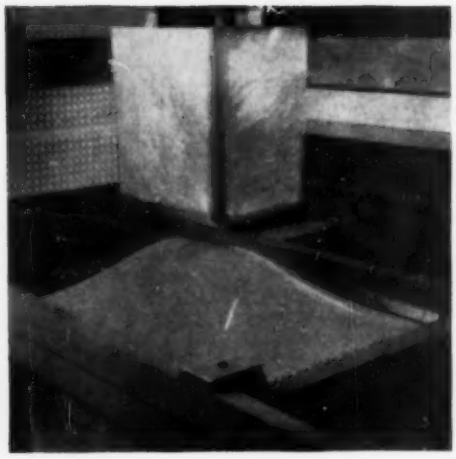


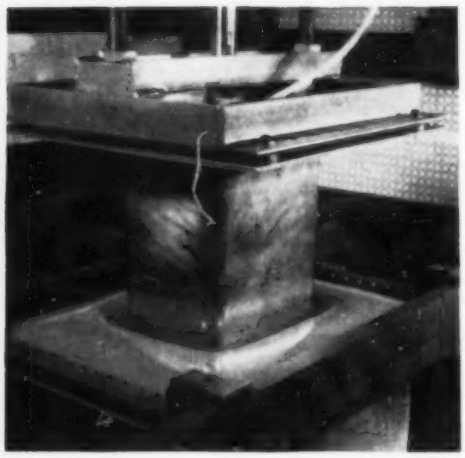
Fig. 7. Broken resin bead on spray mask requires prompt repair.

Fig. 5. Fiberglass-epoxy spray paint mask being removed from finished shroud after spray painting is complete.

Fig. 8. Applying filled epoxy patching material to broken bead of reinforced epoxy spray mask.



As the plug descends, an air cushion from below stretches the plastic to a bubble dome.



Plug descends into bubble. Note how air jets in the plug provide an air cushion on both sides of the sheet.

Formed piece is removed with a minimum of effort.

Deep-Draw Vacuum Forming

A new "Air Cushion Control" process of vacuum forming has been developed by Auto-Vac Co., as part of a design project for the Delaware Barrel Co. Intended for extremely deep-draw forming on a high production basis, the process involves the incorporation of a plug attachment into existing Auto-Vac machines.

Employing this method, it is possible to obtain deep draws, uniform wall thicknesses, and relatively low corner radii with all types and gages of polyethylenes. The method is equally successful with thin- or heavy-gage vinyls, heavy sections of high-impact styrene, and other common thermoplastics. The film development tank shown in the accompanying photos is 12 inches deep, and the wall taper from top to bottom is only two degrees. Corner radii are held to ¼-inch, and the lip radius is ½-inch at the top. Top dimensions are 10½ by eight inches; only slightly less at the bottom.

Cycle time from the end of heating to withdrawal of the plug is a mere 2.5 seconds. A type of pre-forming begins before the vacuum is actually applied. A cavity type mold and a heated assisting plug are used in combination with an ingenious utilization of air pressures to form cushions of moving air on both sides of the sheet. This prevents chilling of the plastic and the molds during the extremely short time of pre-form and stretch.

Plastic sheet material is placed in the clamp frame and brought to molding temperature. When the plastic is sufficiently soft, the frame is dropped slightly below the top of the cavity mold and the "Air Cushion Control" air is introduced into the mold cavity causing the softened plastic to balloon upward. This gives the initial stretch.

A split second later the hot plug-assist with its warm air jets descends into the bubble, stretching it toward the general shape of the mold. This is accomplished while the material is literally suspended between two moving cushions of air. When the plug reaches its maximum descent, the air pressure is replaced by a vacuum. The hot plastic immediately conforms to the shape of the cool mold cavity; air pressure again is exerted; the drape frame is lifted; and the finished part is removed. The above-mentioned "air blow-off" assists in cooling the part. Please see cover illustration for a schematic representation of the process.

—THE END

JEROME L. FORMO,
Director of Plastics Research,
Minneapolis-Honeywell Regulator Co.
Minneapolis, Minn.
and
Chairman, Plastics Institute Committee,
Society of Plastics Engineers, Inc.

Basic Research for the Plastics Industry

THE past decade has seen a growth in the recognition of the value of research which can be likened to the now-popular mushroom cloud symbol of the atom bomb. It has taken dramatic break-throughs to focus national and world-wide attention on the relative importance of basic research in our highly technical culture.

It took radium and X-rays to startle scientists out of the lethargy of satisfaction in their previous accomplishments. The atom bomb of Hiroshima shook the world not only literally, but also figuratively since it presented a new dimension in power. Further refinements and the H-bomb have been almost anti-climactic in their effect on the people of the world.

Now it has taken a Sputnik to dramatize the importance of the spatial break-through which seemed like a science-fiction story to most people. It is safe to say that further improvements in this space science will be forthcoming with little more than passing comment given them. Lethargy slips over us in a most insidious fashion after every important step in progress. It is being realized by more and more thoughtful people that the lethargy about us becomes more deadly as the steps of progress are being rapidly accelerated. Nations must keep awake to be aware of the progress of other nations. And it is different in industry.

Each industry today is struggling to keep up with the news of progress in other industrys. Competition developed through progress has proved to be deadly to those industries lacking means of progress. Paper, steel, cotton, textile, leather, and other industry groups have developed healthy growth as a result of facing up to and doing something about the facts of a competitive economy.

The plastics industry is facing the same certain future as have all other groups. After a period of phenomenal growth, our industry has risen high up the ladder of progress. The mere fact that our industry has been so successful only sets it up as a more attractive target to knock down. It is while we are in this advantageous position that we must take steps to assure the continuation of that position. We cannot be lethargic and rest on our collective industry laurels! Now is the time to take active steps toward the assurance of a successful future.

Perhaps the most promising way in which this assurance can be developed is by the promotion of basic research in plastics. A research operation supported by all phases of the plastics industry should be set up to guarantee that plastics will maintain and increase their relative importance. The value of research has been proved in many fields, including plastics. Much good research work now is being carried on by the members of our industry. However, no center of information, no center of research, and no clearing house of research results exists. In a business as dynamic and as successful as ours, it is easy to understand why this critical lack has not been met. It is difficult, however, to foresee an extended future without such an operation.

In order to determine the needs for such an institute, the Society of Plastics Engineers, Inc., appointed a committee to study the problem and report back in January 1958. The report has been prepared, and is being presented to the National Council of SPE this month. Studies were made of a number of analogous organizations, and answers to many of our questions were noted. The best features from each activities'

(Continued on page 593)

R. B. SEYMOUR, *President*
Loven Chemical of California
Newhall, Calif.

Plastic Pipe in the Chemical Process Industry

The present status of plastic pipe for combating corrosion in chemical processing.

PLASTIC pipe has been used successfully for many years by the American chemical process industry. At first, the materials of construction were limited to ebonite and phenolics. Later, saran and vinyl tubing became available. These materials served the chemical process industry adequately. Most installations were either engineered or based on successful small-scale tests. Hence, failures were few, but annual sales were less than $500,000.00.

In spite of its industrial success, the interest in plastic pipe before World War I was limited. There was very little glamor associated with plastic pipe and, certainly, no million-dollar advertising programs. During World War II, many ersatz materials were used by the chemical process industry in Germany. One of these products was rigid polyvinyl chloride pipe. The results were comparable to that obtained for plastic pipe by American industry before the war, but on a much larger scale.

In contrast to the practice of American chemical industry, German producers of PVC resins used plastic pipe whenever possible. Thus, the German installations were engineered without benefit of manufacturer's promotion or advertising. It is a matter of record that most of the German plastic pipe installations described after the end of World War II are still in service. The confidence in plastic pipe demonstrated by the chemical industry and the successful case histories convinced other potential users of the merits of this material. Plastic pipe has taken its appropriate place among standard materials of construction in Germany.

The reports of the successful use of plastic pipe in Germany published in the late 1940's proved to be interesting reading to those seeking new lines to exploit. The successful use of ebonite, Bakelite and Havig phenolics, and saran pipe seemed unimportant, and PVC became a glamor by-word. The meticulous engineering used in the installation of Vinidur (PVC) pipe in German industry was overlooked. That this pipe was thermally welded, continuously supported, and seldom used at temperatures above 40° C. was considered unimportant.

The prediction that the annual sale of plastic pipe would exceed $200,000,000 by 1965 proved to be the

Based on a paper presented at the 13th Annual Conference, National Association of Corrosion Engineers, St. Louis, Mo., March 11-15, 1957.

most important aspect of the reports by the returning observation teams. Indeed, the anxiety to produce pipe was so great that thousands of pounds of American-made rigid vinyl molding powder were sold before it was established that the product would not produce saleable pipe. Later, it was admitted that the product was not even a rigid vinyl plastic. This observation was not publicized. New extruders were anxious to produce pipe, and not concerned with the chemical composition of the resin.

In 1948, annual sales of plastic pipe were less than one-million dollars. Plasticized cellulose acetate butyrate accounted for much of this volume. Rigid vinyl compounds were introduced during the following year, but extrusion was difficult. Later, the raw materials and extrusion techniques were improved. Polyethylene and styrene-rubber blends also were made available to the plastic extruders.

Over $55-million worth of plastic pipe was purchased in 1956. Even conservative estimates predict that this value should double by 1961, and most of this pipe will be used outside the chemical process industry.

Plastic pipe, when properly selected, fabricated, installed, and maintained, can prove as important in the American chemical process industry as it did in Germany. Hence, corrosion engineers should be cognizant of its advantages and shortcomings. While large-scale installations in chemical industry will probably be engineered and installed by specialists, knowledge of available materials still will be important to all corrosion engineers.

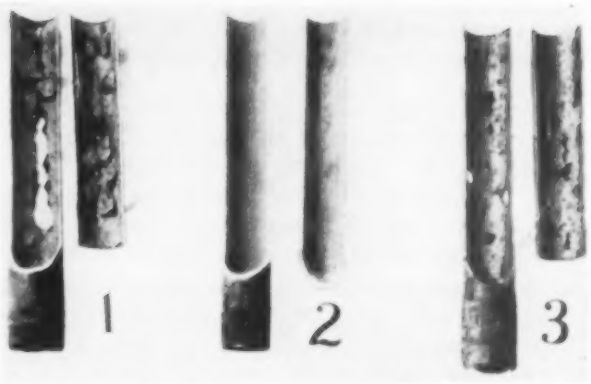
Materials Available

Pipe has been made from thermosetting materials such as phenolic, polyester, furan, and epoxy resins. Thermosetting plastic pipe has been used successfully, but accounts for less than 5% of all plastic pipe used by the chemical industry. Admittedly, fiberglass-reinforced epoxy resin pipe meets many of the requirements of chemical industry (see Fig. 1). Nevertheless, because of its limited use at present, it will not be discussed in this report. It should be mentioned, however, that one type of fiberglass-reinforced resin pipe used successfully in the chemical process industry has a vinyl lining and vinyl outer cover.

Tubing has been extruded from saran, plasticized vinyl, cellulose acetate, and polyvinyl alcohol. These products, like thermosetting pipe, have been used successfully, but play a minor role in the chemical process industry. Hence, emphasis in this report will be placed on extruded thermoplastic pipe.

CELLULOSE ACETATE BUTYRATE. Cellulose acetate butyrate was one of the first plastics to be extruded in large quantity in this country. This product has been approved by the National Sanitation Foundation for use with potable water. Some difficulty has been experienced with highly-chlorinated water, but this product should be completely satisfactory for low-pressure water systems.

Since it is a readily saponifiable ester, it is not recommended for use with corrosive solutions. It has been



(Courtesy: Bakelite Corp.)

Fig. 1. Comparative results for pipe in oil-field service: (1) Cement-lined steel pipe after 24-month's service; (2) Glass-reinforced polyester pipe after 24-month's service; and (3) Plastic-coated steel pipe after nine-month's service.

(Courtesy: Dow Chemical Co.)

Fig. 2. Cross-sections of four-inch Saran-lined steel pipe.

(Courtesy: Atlas Mineral Products Co.)

Fig. 3. Styrene copolymer-rubber resin blend pipe and fittings.

used successfully in large quantity for the transportation of petroleum, salt water, and natural gas.

SARAN. Saran has a longer history of successful use than does any other thermoplastic pipe. Like cellulose acetate butyrate, it contains a small amount of plasticizer and, hence, tends to become embrittled after many years of service. Nevertheless, successful installations with almost 15 years of service in chemical industry are on record.

Saran pipe is somewhat more expensive than most other thermoplastic pipe. It has not been promoted as widely as polyethylene or vinyl, and its use has been limited.

Saran pipe has been used for many years to line steel pipe. Saran-lined pipe has been sold on the basis of performance, rather than price (see Fig. 2). The many recorded case histories of its successful use are reassuring. Also, as discussed later in this report, this success should stimulate additional creativity in the plastic pipe industry.

STYRENE—RUBBER BLENDS. Pipe made from blends of copolymers of styrene with acrylonitrile and butadiene-acrylonitrile have been promoted aggressively. This type of pipe is an American development that meets many of the requirements of the chemical industry (see Fig. 3).

A competitive product having outstanding impact resistance is presumed to be copolymer of all three monomers. The producers of this resin have supplied considerable technical data that should aid the extruder and the engineer in the proper use of this type of pipe.

POLYETHYLENE. Low-density polyethylene lacks rigidity, and cannot be used universally as a replacement for rigid pipe. In contrast, the newer high-density polyethylene pipe is rigid and can be used in rigid plastic pipe.

(Courtesy: Atlas Mineral Products Co.)

Fig. 4. Extrusion of 1½-inch Type I (normal impact) rigid PVC pipe with a twin-screw extruder.

Low-density polyethylene usually is joined by insert-type joints. This technique hampers its use somewhat in the chemical process industry. Nevertheless, when its pressure limitations are recognized, it has proved satisfactory, for the transportation of potable water. It is not affected adversely by most aqueous corrosive solutions.

The new high-density polyethylene pipe will be used in chemical industry, but will not be the solution to all piping problems. Actually, many of the properties claimed for high-density polyethylene pipe are comparable to those exhibited by other types of rigid plastic pipe.

These statements should not be considered as a condemnation of either type of polyethylene pipe. At least 75% of all plastic pipe produced today is based on polyethylene. This statement will be equally true in 1962, but it is important for corrosion engineers to recognize the limitations of polyethylene as well as all other types of plastic pipe.

RIGID POLYVINYL CHLORIDE. While polyvinyl chloride was known for many years in this country, it could not be used commercially until plasticizing procedures were developed. Tubing extruded from the plasticized resin, of course, was flexible. An intensive investigation of the polymerization produced a resin which could be extruded without the addition of plasticizer. The resultant rigid vinyl pipe has been used successfully in Germany for 15 years. It was produced in small quantity in the United States in 1948 (see Fig. 4).

Unfortunately, too little attention was paid to the precautions used by the German chemical industry. For example, German engineers recognized rigid PVC's inherent brittleness, high coefficient of expansion, the decrease in strength with increased temperature, and creep. Yet, German engineers designed around these characteristics.

In contrast, American resin producers attempted to reduce brittleness, and unavoidably increased the coefficient of expansion and reduced the chemical resistance. Likewise, attempts to increase the resistance of the pipe to bursting pressure by increasing wall thickness resulted in greater weight and higher cost. Other equally disappointing modifications could be related.

Today, two types of rigid vinyl pipe are available to corrosion engineers, in this country; i.e., Type I or normal impact, and Type II or optimum impact. German engineers continue to use Type I rigid vinyl pipe with outstanding success.

MISCELLANEOUS RESINS. Pipe extruded from polymethylmethacrylate is transparent, but has limited use in the chemical process industry. Pipe extruded from nylon has shown considerable promise in hot water service. Pipe extruded from a chlorinated polyether produced from pentaerythritol has excellent heat and chemical resistances. This product still is in the pilot plant stage, and is very expensive.

Polyfluorocarbon pipe and tubing also is expensive, but has exceptional resistance to heat and corrosives

Table 1. Typical Sizes of Pressure-Rated Polyethylene Pipe.

Nominal Size, in.	Schedule 40 Pipe		Schedule 80 Pipe		SWP Pipe		100-psi. Pipe		75-psi. Pipe	
	OD, In.	ID, In.	OD, In.	ID, In.	OD, In.	ID, In.	OD, In.	ID, In.	OD, In.	ID, In.
1	1.315	1.049	1.315	1.957	1.14	1.00	1.230	1.050	1.175	1.050
2	2.375	2.067	2.375	1.939	2.25	2.00	2.422	2.067	2.317	2.067
3	3.500	3.068	3.500	2.842	3.25	3.00	—	—	—	—
4	4.500	4.026	4.500	3.749	4.10	3.80	—	—	—	—
6	6.625	6.065	6.625	5.761	6.22	5.76	—	—	—	—

(see Fig. 5). Much of this product is reinforced. Metal pipe lined with polyfluorocarbon tubing, similar to saran-lined pipe in design, now is available commercially.

Advantages and Disadvantages

Most plastic pipe lacks resistance to organic solvents, but has good resistance to corrosive solutions. In addition, the interior of the pipe is smooth; hence, there is less chance for build-up of paraffin and other deposits in the line. Thus, it often is possible to use smaller diameter pipe when replacing metal with plastic.

Plastic pipe has a lower specific gravity than most other types of pipe. Thus, if the functional advantages are recognized, a light-weight pipe can be produced. Plastic pipe can be manufactured with a small investment in equipment. As outlined later, this may prove to be of great importance to the chemical process industry.

On the other hand, plastic pipe lacks resistance to excessive internal pressure, has a high coefficient of expansion, and must be supported almost continuously. It generally is not satisfactory for temperatures above 140° F., and is subject to cold flow. These characteristics are inherent and must be recognized. Germaa engineers have designed around these shortcomings in order to utilize the advantages. Certainly, American engineers can do as well.

Standards and Certifications.

The lack of standards and specifications plagues all new industries, and the plastic pipe industry is no exception. Since most of the early American extruders decided to thread plastic pipe, they designed pipe with a thickness greater than the depth of the thread and, therefore, selected schedule 80 i.p.s. as a standard. Later, schedule 120 i.p.s. was made available. The cost of the increase in working pressure, however, is difficult to justify.

Other fabricators joined pipe by applying solvent to the fittings, thus making use of the full thickness of the pipe. These extruders saw no reason to adopt schedule 40 or 80 pipe, and developed a thin-walled, solvent-welded pipe. Later, it was concluded that a universal pressure rating was more important than schedules, so that a new series was developed in which certain calculated pressures could be withstood, regardless of the diameter of the pipe. These concepts are much more important to the water and gas companies than to the chemical industry, and some of this information on pipe thickness is summarized in Table 1.

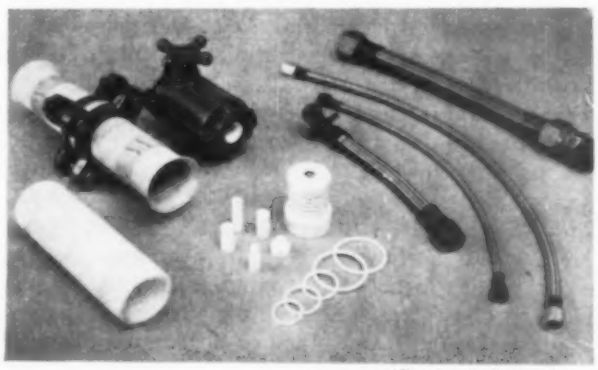
As a result of an investigation sponsored by members of the SPI thermoplastic pipe division at the National Sanitation Foundation, it was shown that most thermoplastic pipe was suitable for the transportation of potable water. In order to insure the consumer that the pipe is suitable, a certification system has been established and approved pipe carries the NSF seal. A program for the development of much needed engineering data has been sponsored by the same group at Battelle Memorial Foundation. Much of this investigation is directed toward the development of short-term tests to predict actual performance of plastic pipe.

The thermoplastic pipe division of the Society of the Plastics Industry also has been very active in aiding in the establishment of voluntary standards. The Commodity Standards Division of the U. S. Department of Commerce already has officially approved dimensional tolerances for many types of plastic pipe. These specifications have been presented to the joint SPI-ASTM Plastic Pipe Committee and the ASA committee for consideration as official standards by these associations.

Pipe Bursting Pressure.

Considerable time has been spent on determining the ultimate pressure resistance of plastic pipe. While Barlow's formula may be refined (i.e., Lame's formula, etc.) the data obtained from Barlow's formula are adequate for predicting the bursting strength of pipe. The following formula is valid when the tensile strength and burst pressure are measured at the same temperature when exposed to the same corrosive environment.

$$\text{Internal Pressure, psi.} = \frac{2\,(\text{Wall Thickness, in.})\,(\text{Effective, Tensile Strength, psi.})}{\text{Outside Diameter, in.}}$$



(Courtesy: Resistoflex Corp.)

Fig. 5. Pipe, valves, and rings of polyfluorocarbon plastics.

Values for effective tensile strength at various temperatures are much lower than the often-misused ultimate or short-time tensile strength values, since the former allows for creep. Effective tensile strength values now are being supplied by leading resin manufacturers.

When the above formula is used conservatively, (i.e., with a factor of safety of 4), plastic pipe will perform satisfactorily along with other types of pipe. Simple cost calculations, however, will show that it is not economically sound to increase the thickness of plastic pipe to accommodate high pressures. Obviously, armouring of SWP pipe or inserting thin plastic pipe inside metal pipe is a more economical and sounder approach.

Plastic Pipe Experiences

Successful installations measured in miles and hundreds of miles prove conclusively that when properly selected and installed, plastic pipe is an accepted material of construction. More than 300 miles of plastic pipe was installed by gas distribution firms when shortages of other materials were encountered. The performance of the plastic pipe continues to meet all expectations, but its use in many cases has been discontinued when previously-used pipe became available.

Nine miles of cellulose acetate butyrate was installed in the Williston oil basin for transporting petroleum crudes in 1954. Fourteen miles of ¾-3 inch plastic pipe was installed at the Porterville State Hospital in California in 1955. Two miles of polyethylene pipe for transporting potable water at Grandfather Mountain, North Carolina were laid by helicopters. Similarly, 98 miles of styrene rubber-blend pipe were installed in the Texas panhandle for transporting natural gas in 1956. Considerable quantities of solvent-welded rigid vinyl pipe have been installed on naval ships for decontamination purposes.

Many other large-scale uses could be cited to prove that plastic pipe is performing satisfactorily. Since answers usually are found in the market place, the annual sales total of more than $50,000,000 probably will outweigh all testimonials or case histories.

While used to a much smaller extent in the chemical process industry, plastic pipe has performed satisfactorily. More than 10,000 feet of polyethylene pipe has been used successfully as an insert in existing metal lines by potash firms. Better than 60% success was reported to the National Association of Corrosion Engineers by users who had installed more than 110,000 feet of plastic pipe in the chemical industry. It is of interest to note that all but 7% of the faulty lines were repaired satisfactorily.

One of the leading producers of polyvinyl chloride resins has used vinyl pipe in many installations in its various plants. As might be anticipated, the only failures noted were in the presence of solvents and at high pressures when water hammer was encountered.

Experience in both this country and abroad proves quite conclusively that rigid plastic pipe, when properly supported, is satisfactory for transporting most aqueous corrosive solutions at temperatures below 125° F. and at moderate pressures. Plastic pipe also has performed satisfactorily at temperatures as high as 160° F., and at pressures up to 100 psi. Such unusual case histories, however, should be considered as exceptions rather than as recommended services.

When corrosive engineers examine the characteristics of plastics and the experiences to date, they will conclude that few materials show as much promise as rigid plastic pipe. Unfortunately, too many have become so enthusiastic that they have forgotten characteristic shortcomings such as decrease in strength with increase in temperature, high coefficient of expansion, and creep. When recognized, these deficiencies can become assets.

Overcoming Shortcomings

Common sense will prove that plastic pipe can outperform many other materials of pipe construction. Creativity, however, is essential if the greatest satisfaction is to be achieved. Engineers have no monopoly on this important attribute, and it is not surprising to learn that maintenance personnel, when allowed to make suggestions, have overcome many of the shortcomings of plastic pipe. Some of the ideas advanced to date are related here.

Some 10% of all cast-iron lines burst in England during the cold winter of 1955, yet the plastic pipe lines were completely satisfactory. One of the ditch diggers who recognized this important phenomenon suggested that a ½-inch tube of polyethylene sealed at both ends be inserted into the cast-iron water lines. As might be expected, it is impossible for ice to burst a water line when it forms around a hollow tube of flexible polyethylene.

An operator in a chemical plant who had used polyethylene pipe on his farm suggested that it be inserted in a leading metal acid line. The results were good enough to warrant the adoption of this technique throughout the plant.

In another instance, rigid vinyl pipe was purchased for transporting hot dilute sulfuric acid in a plant manufacturing dyestuffs. The pipe was solvent welded and supported every 12 feet. After one week, the pipe was badly distorted and was condemned. At the suggestion of one of the maintenance men, scrap steel pipe was placed around the plastic pipe. At present, the installation is a point of interest in this plant since it has given trouble-free service for more than one year.

Many other cases could be cited to show the importance of both common sense and ingenuity in the use of plastic pipe. However, it should not be inferred that engineers lack creativity. Actually, brain-storming sessions instituted subsequently in two of these plants showed the engineers to be unusually creative. The important point is that plastic pipe, when properly selected and installed, can be a great asset in combatting corrosion.

Future Outlook

There is a tremendous opportunity for ingenuity when using plastic pipe. Most of the needed innovations and improvements will not be made by the resin manufacturer or the extruder, but by the user. A few

(Continued on page 50)

A. D. COGGESHALL, *Engineer,*
Materials & Processes Laboratory,
Large Steam Turbine-Generator Dept.,
General Electric Co.,
Schenectady, N. Y.

Significance of Second-Order Transitions of Polyester and Epoxy Resins in Glass Fiber-Reinforced Laminates

Exhaustive tests show the resins to have a characteristic temperature- and stress-dependent rheology that requires use of appropriate stresses for duplication in laminates.

RUBBERS and certain polymer structures are described in the literature (1,2,3)* as existing in both a "glassy" and a "rubbery" state; the "glassy" state being associated with low temperatures, and the "rubbery" state being associated with higher temperatures. The transition between these two states occurs over a small temperature range, and is referred to as the second-order transition temperature, the glass transition temperature, or simply as the "glass point."

Below the glass transition temperature, the mechanical properties of the material are largely governed by forces of intermolecular attraction resulting in brittle bodies of high elastic moduli and low elongations at breaking. Above the glass transition temperature, the polymer chains are relatively free to uncoil, resulting in materials of low modulus and high elongation at rupture. Relative movement of polymer chains or chain segments also is possible.

More precisely, the glass transition temperature is taken as that temperature where the polymer chains acquire sufficient thermal energy to permit rotation about carbon-carbon bonds. The polymer then acquires a new degree of freedom, resulting in large changes in properties over a narrow temperature range.

Since similar transitions theoretically are possible in the resins used in reinforced plastics, the purpose of this discussion is to demonstrate their existence and and show their importance and significance to the

*Numbers in parentheses refer to bibliography at end of article.

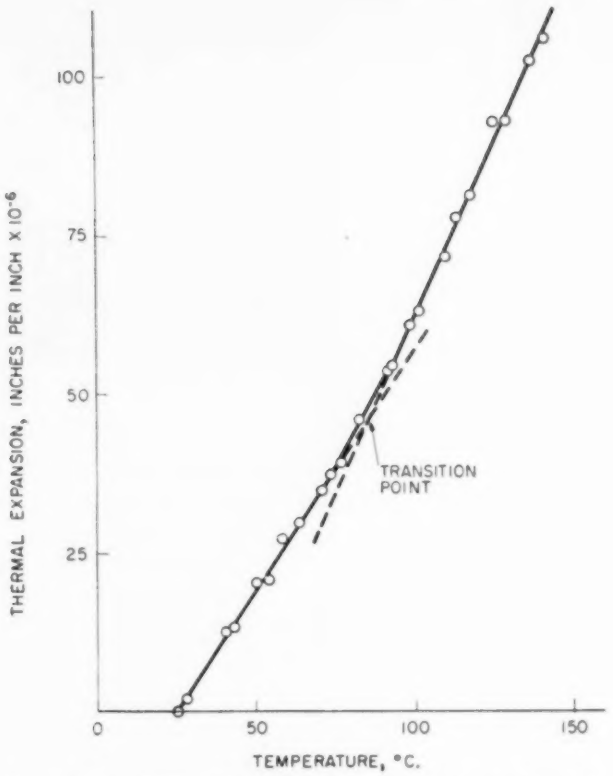


Fig. 1. Determination of transition temperature by a change in the rate of thermal expansion of Resin C with increasing temperature.

engineering properties of reinforced plastics.

Glass-Transition Temperature

Alfrey (1) shows that if the reciprocal of the density of a polymer is plotted against temperature, a discontinuity in slope occurs at the temperature where the molecule acquires a new degree of freedom. In this work, thermal expansion has been substituted for specific volume because thermal expansion measurements may be reduced readily to a routine basis.

Figure 1 shows the results of such an experiment on clear, unfilled castings of Resin C (a highly-reactive styrene-base polyester recommended for high-temperature strength retention. Thermal expansion, in inches per inch, is plotted against temperature, and it is seen that a change in slope occurs between 80° and 90° C. The straight portions of the curve have been extended, and the point of intersection at approximately 88° C. is taken as the temperature of transition.

This value is quite low, considering that the material in question has an excellent reputation for high-temperature strength retention, and freedom from creep. In order to show if the thermal expansion method for determining glass points has engineering significance, correlation will be attempted with the following mechanical properties of laminates molded from this resin:

(1) Flexural strength.
(2) Flexural modulus of elasticity.
(3) Short-time flexural creep.
(4) Heat distortion point.

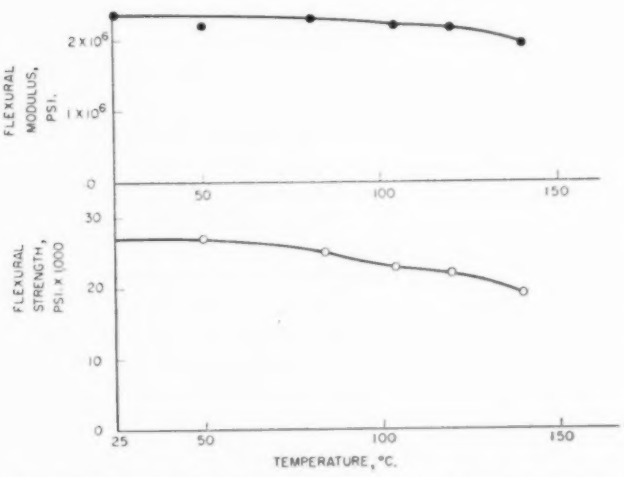


Fig. 2. Effect of temperature on flexural modulus and flexural strength for a laminate of 15 plies of 16 x 14 construction, 12-mil glass cloth using Resin C.

Effect Of Flexural Strength

Figure 2 is a plot of the flexural strength of a laminate of 15 plies of 16 x 14 construction, 12-mil "Boat cloth"** molded with Resin C polyester as a function of temperature. The test specimens were molded to stops for a finished thickness of 3/16-inch, and machined to 0.500-inch wide. The resulting strips were loaded as simple beams on four-inch supports, and the strength measured at 25, 50, 84, 105, 120, and 140° C. It is seen that above 50° C. there is gradual loss of flexural strength, but this data cannot be interpreted to show any definite transitions.

Effect Of Flexural Modulus

Flexural modulus data taken incidental to the determination of flexural strength show that there is a gradual loss of modulus above 120° C, but these data cannot be interpreted to show any marked transition phenomena

Transition phenomena in reinforced plastics may be demonstrated with the use of constant stress at several temperatures. A number of experiments will be discussed to show the relation of glass-point transitions to temperature, stress, loading time, and type of reinforcement in the specimen. Resin C will be used throughout this series of experiments.

Effect Of Loading Time

Test results for a number of closely similar specimens loaded in bending at constant stress at a number of temperatures, so that bending of the beam is followed with time, are shown in Figure 3. It is seen that both the initial deflection of the beam and the rate of creep increase with temperature. In this example, an increase in both these quantities appears between 50° and 80° C. Curves taken at 90°, 100°, and 110° C. are closely similar. Above 120° C., the behavior of the samples in bending are dominated by plastic action. These data are taken as evidence that both the decay of flexural modulus of the material and the rate of creep lead to a general loss of stiffness which is gov-

**Commercial examples of this fabric are United Merchants Corp. Style 1000, Hess Goldsmith HG 63, and Soule Mills SM-500.

erned by some discontinuous function of temperature.

A clearer picture emerges when the data is reworked in terms of a constant specimen load-deflection proportional to loss of stiffness. This is done by comparing the difference in bending of a given specimen when loaded successively at two temperatures; for example, room temperature and some elevated temperature. The reference zero for the experiment will be the initial deflection of the beam at 25° C. "Loss of stiffness" will be taken as any additional bending resulting from both extended loading and higher temperature. It is understood that the room-temperature loading will only be that to obtain the deflection at the instant of loading, that the sample then is unloaded and brought to full test temperature. The sample then is reloaded for as long as desired. Because the creep observed has a rapid time-scale, loading should be done as quickly as possible, and a single dead weight is a convenient means for doing this.

The deflection vs. time data of Figure 3 is replotted (see Figure 4) to show the "loss of stiffness" as previously defined of the individual specimens as a function of temperature. The data is taken to show the effect of loading for one second, two minutes, 30 minutes, and one hour. Using this method of organizing the data, a number of interpretations may be made.

As shown in Figure 3, the loss of stiffness is made up of a lowering of the elastic modulus and an increase in plastic action. The relative contribution of these two effects may be estimated by inspection of Figure 4. It is seen that the glass-point of 86° C. from thermal expansion measurements predicts an abrupt change in modulus which is reasonably constant from 90-120° C. The creep rate also is reasonably constant over the same temperature range. Above 120° C., the "loss in stiffness" is dominated increasingly by time-dependent plastic action, so that it assumes a run-away aspect in the neighborhood of 150° C.

The trend of this data is shown adequately by loading periods of only two minutes. For the rest of the investigation, two minute "loss of stiffness" values will be reported. The use of such a short loading period makes it possible to survey a wide range of experimental conditions with the knowledge that increasing the loading period will magnify the effects reported. The order of magnification can be estimated from Figure 3.

The two-minute stiffness is given by:

$$\Phi st = D_t - D_o$$

where Φst is the loss of stiffness at stress s and temperature t; D_t is the deflection in mils of the standard specimen at temperature t after two minutes at stress s; and D_o is the initial deflection of the same specimen at 25° C. and stress s.

Nominal bending stress is given by the following relationships:

$$\text{Stress} = \frac{3\ (\text{Load}) \times (\text{span})}{2\ (\text{Width}) \times (\text{thickness})^2}$$

It is recognized that a rigorous analysis of bending stress is complicated, and that the foregoing relationship serves chiefly as a means of reducing data taken on specimens of slightly varying sizes to a common basis.

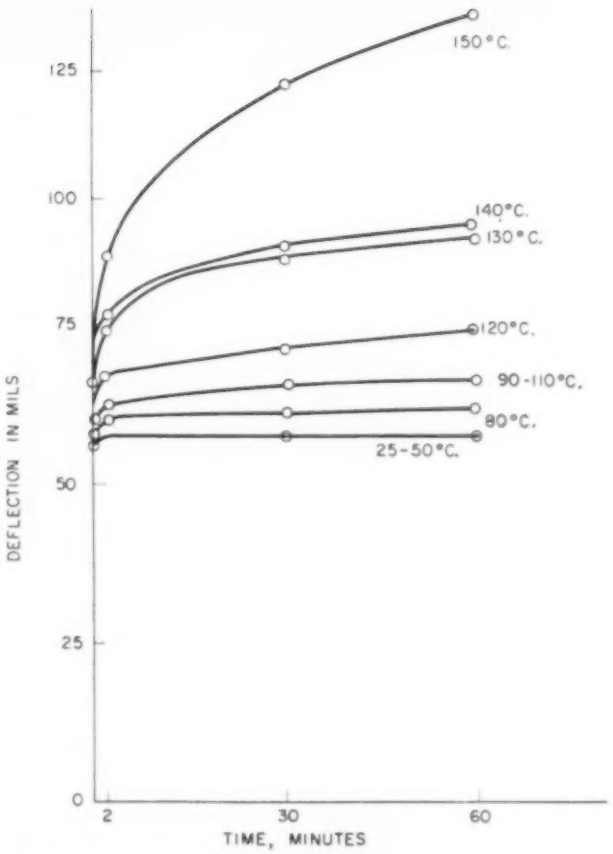


Fig. 3. Effect of time on deflection at a 9,000-psi. nominal bending stress of a 16 x 14 construction, 12-mil glass cloth laminate using Resin C.

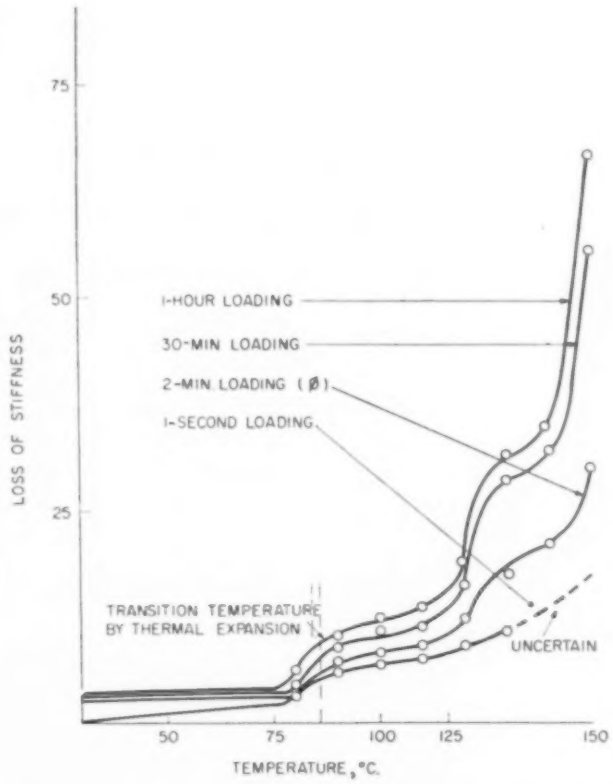


Fig. 4. Effect of temperature on loss of stiffness for several loading periods at a nominal bending stress of 9,000 psi.

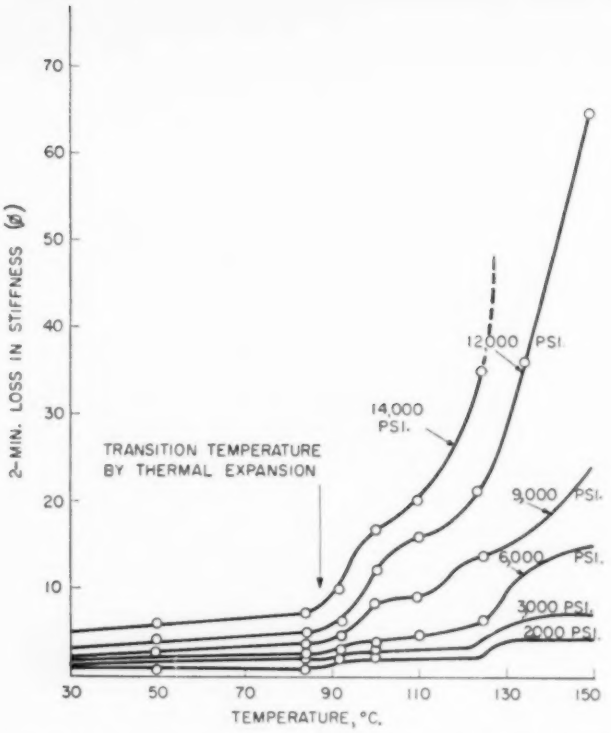


Fig. 5. Effect of temperature on two-minute loss of stiffness at several bending stresses from 2,000-14,000 psi.

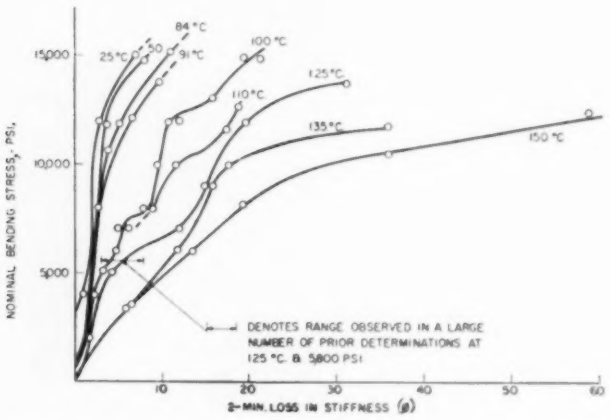

NOMINAL BENDING STRESS, PSI.
2-MIN. LOSS IN STIFFNESS (φ)
DENOTES RANGE OBSERVED IN A LARGE NUMBER OF PRIOR DETERMINATIONS AT 125 °C. & 5800 PSI

Fig. 6. Effect of stress on two-minute loss of stiffness at various temperatures.

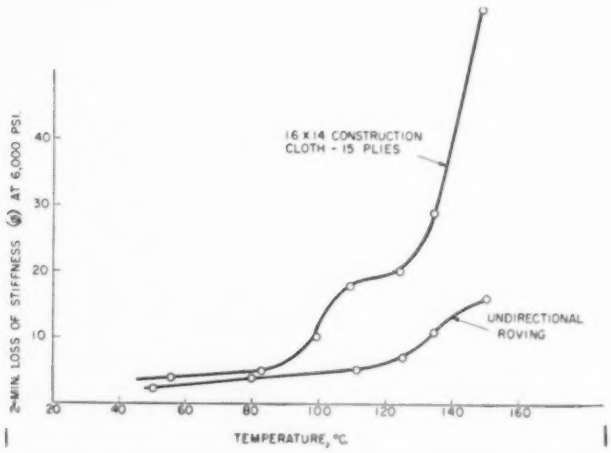


Fig. 7. Comparison of 16 x 14 construction, 12-mil cloth and unidirectional roving in laminates with Resin C.

Effect Of Bending Stress

The information previously discussed was taken at only one bending stress, 9,000 psi. The effect of varying this stress from 2,000 psi to 14,000 psi is shown in Figure 5. It is seen that the loss of stiffness (Φ), as defined previously, is strongly dependent on stress. When the stress is an appreciable fraction of the breaking stress, the threshold of loss of stiffness coincides with the glass-point given by thermal expansion measurements. At low stress, loss of stiffness is hard to measure in the temperature range investigated.

The irregular shape of the curves is explained with the aid of Figures 3 and 4 which indicated that the elastic modulus of the resin goes through an abrupt change at the glass-point, but is reasonably constant with temperature at each side of the transition. At high stress, the observed loss in stiffness in the range from 90-120° C. is due principally to modulus change, and the contribution due to plastic action is small. Above 120° C., the plastic action contribution becomes increasingly dominant, and the curves show a sharp up turn.

At low stress, the observed loss in stiffness become, almost nil for temperatures up to 150° C. The resolution of the data does not permit a clear separation between the relative contributions of modulus loss and plasticity. It is believed that plastic action is comparatively unimportant at low stress, and any observable stiffness loss is due primarily to modulus effects.

Effect Of Stiffness Loss

The same data as in Figure 5 has been cross-plotted (see Figure 6) to show loss of stiffness as a function of stress at several temperatures. Of particular interest is the behavior at lower temperatures.

The curves for 25°, 50°, 84°, and 91° C. are closely grouped, and show definite loss of stiffness with increasing stress. This loss of stiffness is not due to plastic action in the resin, as in the case at higher temperatures. Instead, minute brittle fractures seem to be occurring in the structure as evidenced by an intermittent creep rate, slight snapping and crackling sounds from the specimen, and microscopic evidence of cracks in the glass fabric after the completion of the

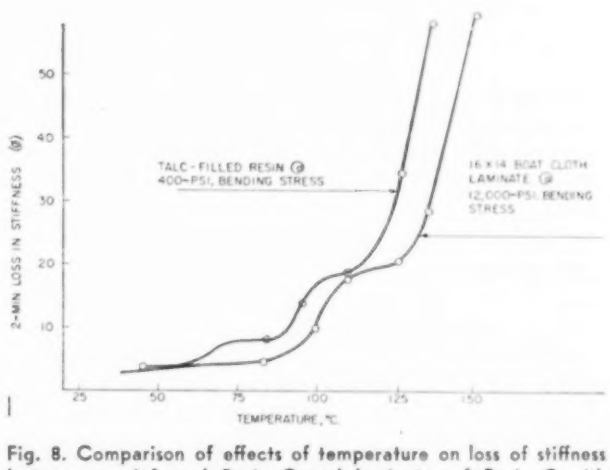

2-MIN LOSS IN STIFFNESS (φ)
TALC-FILLED RESIN @ 400-PSI. BENDING STRESS
16 X 14 BOAT CLOTH LAMINATE @ 12,000-PSI. BENDING STRESS
TEMPERATURE, °C.

Fig. 8. Comparison of effects of temperature on loss of stiffness between unreinforced Resin C and laminates of Resin C with 16 x 14 construction, 12-mil cloth.

loading cycle. Again, this phenomena has a rapid time-scale, and is best observed by bringing the specimen to full stress in as short a time as possible.

It is suggested, therefore, that the conventional short-time flexural strength test involves a large number of tiny fractures in the specimen that precede the main failure. The time-scale of the conventional flexural test is such that this microdeterioration of the specimen does not make itself felt. This is advanced as one reason for the unrealistically high results obtained from flexural strength testing. This concept also supports the work of B. B. Pusey (4) who found the 1,000-hour strength of a laminate to closely approach the endurance limit for an indefinite time.

Effect of Reinforcement Type

All experiments thus far have discussed only one type of reinforcement (15 plies of 16 x 14 construction cloth.). The nature of the effects being studied is revealed more fully by making loss-of-stiffness measurements for different types of reinforcements.

The first effect of a change in reinforcement is an apparent change in the temperature of transition; higher transitions being associated with high-performance reinforcements. Figure 7 compares the standard 16 x 14 cloth reinforcement with unidirectional fiber at 13,000-psi. bending stress. For a comparable loss in stiffness, the unidirectional fiber shows at temperature advantage of about 35° C. At first sight, this result is in apparent conflict with the concept that the change in state of the molecule leading to these transitions occurs at a fixed temperature and, therefore, should be independent of reinforcement.

It has been shown in Figure 5 that the apparent temperature of transitions is a function of stress. This is confirmed by the work of Gouza and Bartoe (7) who made heat distortion temperature determinations on thermoplastics as a function of stress. In a reinforced structure, the stress is distributed between the resin and the reinforcement; the more efficient the reinforcement, the less the stress on the resin. The concept now is advanced that comparable transition phenomena may be demonstrated in a wide variety of reinforcements, provided the resin in each sees comparable stress.

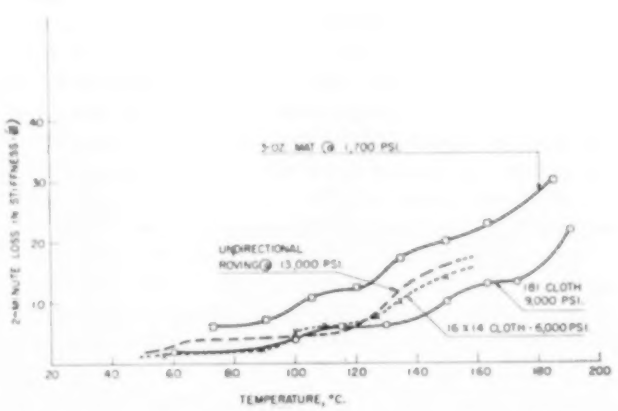


Fig. 9. Similarity of loss of stiffness vs. temperature characteristics for glass mat, two types of glass cloth, and unidirectional roving in laminates of Resin C.

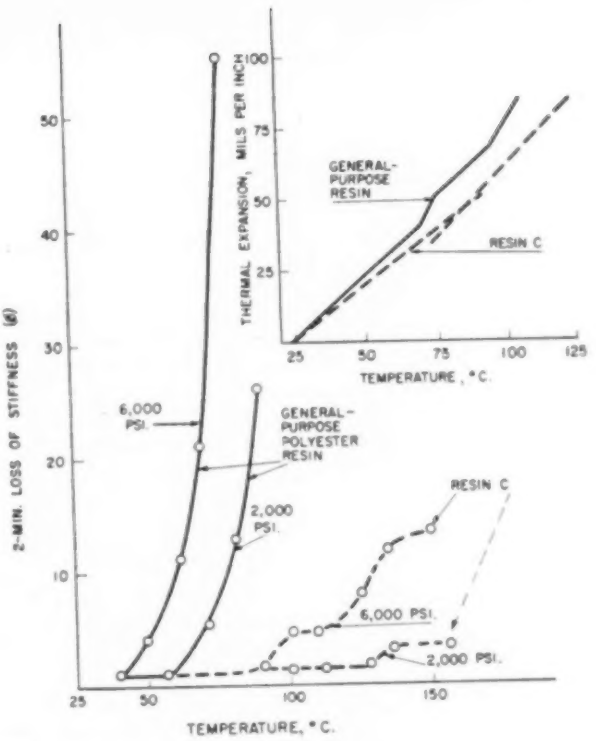


Fig. 10. Similarity of loss of stiffness vs. temperature for Resin C and general-purpose polyester resin laminates with glass mat, two types of glass cloth, and unidirectional roving at appropriate levels of bending stress. Inset (upper right) shows transition temperatures given by thermal expansion tests.

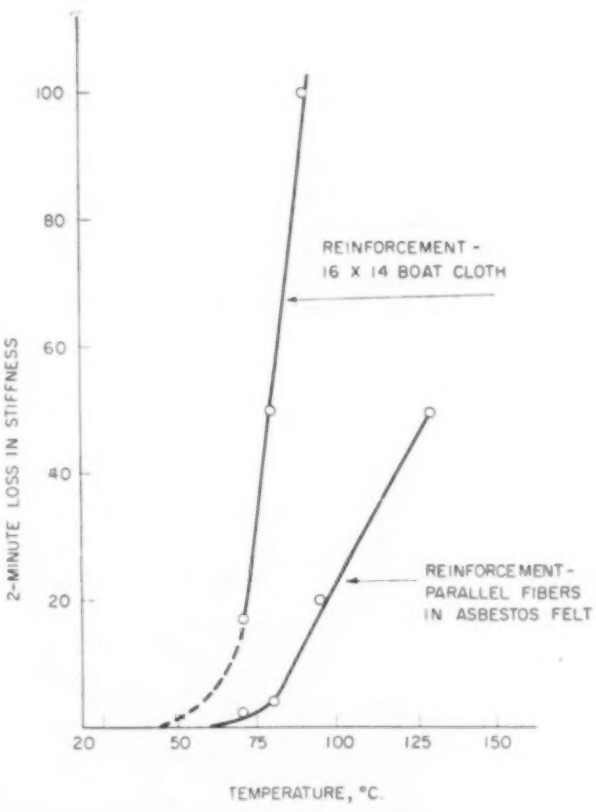

2-MINUTE LOSS IN STIFFNESS
REINFORCEMENT - 16 X 14 BOAT CLOTH
REINFORCEMENT - PARALLEL FIBERS IN ASBESTOS FELT
TEMPERATURE, °C.

Fig. 11. Comparative effects of two reinforcement types on loss in stiffness vs. temperature characteristics of an epoxy resin containing dicyandiamide curing agent.

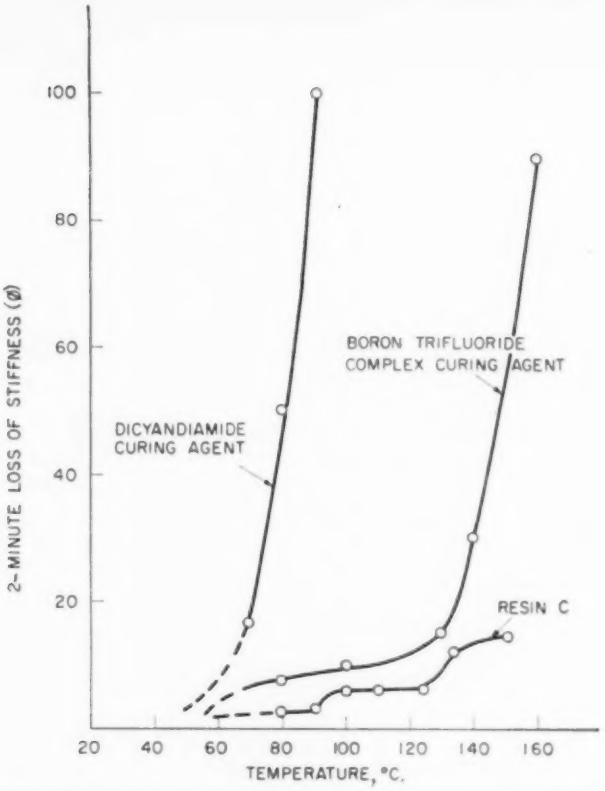


Fig. 12. Comparative loss of stiffness vs. temperature characteristics at 5,800-psi. nominal bending stress for an epoxy resin with two types of curing agents. Comparable data for Resin C also are indicated. Laminate reinforcement was 15 plies of 16 x 14 construction, 12-mil cloth.

To support this view, loss of stiffness (ϕ) vs. temperature characteristics were obtained on specimens cast from 30% talc-filled Resin C, and are shown in Figure 8. The striking increase in plastic action above 120° C. that has been typical of this material is well demonstrated. The 12,000-psi. curve of ϕ vs. temperature for a laminate made from 15 plies of 16 x 14 construction cloth is replotted from Figure 5 on the same scale. The similarity is striking, indicating that the resin in the talc-filled specimen and in the laminate experienced the same order of stress.

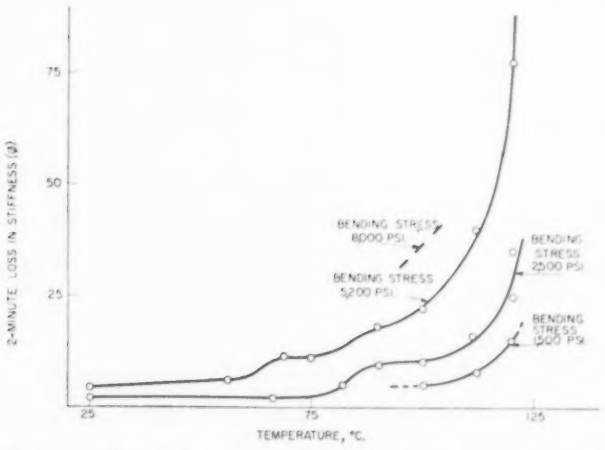


Fig. 13. Effect of temperature on loss of stiffness at several bending stresses for an epoxy resin laminate with a boron trifluoride-complex curing agent and a composite reinforcement of asbestos paper and three-mil glass cloth.

Stiffness loss vs. temperature determinations were made on specimens molded from a number of typical reinforcements at several stress levels. A selection was made to determine which stress levels gave comparable ϕ vs. temperature response. These are shown in Figure 9, and the laminate constructions are shown in Table 1. Limitations of the apparatus did not permit loading the 181 cloth or the unidirectional roving to higher stress levels to show if the observed duplications were maintained over a wide variety of stress levels.

This procedure may be considered to measure the efficiency of the reinforcement which is influenced by the sizing or coupling agent. Preliminary information shows that differences between chrome-complex and silane-type finishes can be demonstrated by this approach.

Effect Of Resin Cure

It has been shown (6) that loss of stiffness determinations at fixed stress and temperature were strongly dependent on the degree of cure of the specimen, and this approach was used to predict optimum curing conditions. It is now believed that incompletely cured material may be considered to have a lower glass-point and show more plastic action. A comprehensive discussion of factors influencing optimum cure may be found in this prior work (6.)

Table 1. Stress Levels for Comparable Epoxy Laminate Stiffness Loss vs. Temperature Characteristics with Various Reinforcements

Nominal Bending Stress, Psi	Type of Reinforcement
1,700	Two plies of three-oz. mechanically bonded glass mat.
6,000	15 plies of 14 x 16 construction cloth, 114 finish.
9,000	24 plies of 181 glass cloth, 136 finish.
13,000	Unidirectional roving, (generally similar to fishing rod stock.)

Comparison Of Resins

All the information heretofore presented has been concerned with one particular cross-linked type of polyester resin. A limited amount of work has been done with other materials and show the same pattern of results appearing at different temperatures and stress levels. Data will be presented on a general-purpose polyester resin, and several epoxy types.

Figure 10 shows the loss of stiffness data for a general-purpose polyester resin designed solely for room-temperature use compared to resin C. The inset in the figure shows thermal expansion data for these materials. In the case of Resin C, the dilatometric transition temperature appears at the threshold of loss of stiffness phenomena. This is not the case with the general-purpose resin as it shows marked loss in stiffness at temperatures well below the glass-point as

given by thermal expansion. The difference in behavior in the thermal expansion experiment is very small considering the very large differences obtained in experiments involving deformation at constant load.

A study of two types of reinforcements with an epoxy resin is shown in Figure II. In one case, the reinforcement is the standard 16 x 14 construction cloth, and in the other is a special unidirectional fiber felted with asbestos fibers. A dicyandiamine hardener was used with the resin. The unidirectional fiber shows a temperature advantage of about 20° C. over the fabric for comparable loss in stiffness. This effect is ascribed to the more efficient unidirectional reinforcement assuming a greater share of the load so that the resin, in effect, behaves as if it were stressed at a lower value.

The glass-transition temperature of epoxy resins is greatly dependent on the type of hardener used. Figure 12 compares dicyandiamine with a boron trifluoride-complex curing agent, using 16 x 14 cloth and a 5,800 psi. bending stress. The heat distortion temperature of the particular resin formulation using boron trifluoride hardener was determined at 163° C.

Data on this same epoxy system with the boron trifluoride-complex curing agent with three-mil glass cloth combined with asbestos paper reinforcement is shown in Figure 13. The same dependence of apparent transition temperature on stress that has appeared elsewhere is shown in this example. In this case, the mechanical properties of the system in bending are dominated by plastic action above 125° C. As previously mentioned, the heat-distortion temperature of the clear resin is 163° C.

Comparison With Heat Distortion Test

The ASTM heat-distortion temperature test is an established procedure to examine materials for transition phenomena. The test is made with a half-inch square beam centrally loaded on four-inch supports to a nominal bending stress of 264 psi. The loaded beam then is heated at a predetermined rate, and the deflection of the beam is followed with increasing temperature. Presumably as the sample approaches its softening or transition temperature, a large increase in deflection will be observed. The heat-distortion temperature has been fixed arbitrarily as that temperature at which the beam deflects 10 mils.

The words "heat-distortion temperature" may leave, by suggestion, the implication that this temperature is a physical constant of the material, and that distortion under load does not take place below this temperature. While those familiar with the procedure appreciate that its usefulness is principally as a basis for comparison, the impression has grown that heat-distortion temperatures have engineering significance. It will be shown that the procedure, as now constituted, contains certain inherent errors that may yield results substantially higher than the actual softening temperature of the specimen under test.

Figure 14 depicts the experimental set-up, and it will be noticed that thermal expansion of the specimen will drive the measurement system in the opposite direction than will the downward bending of the beam.

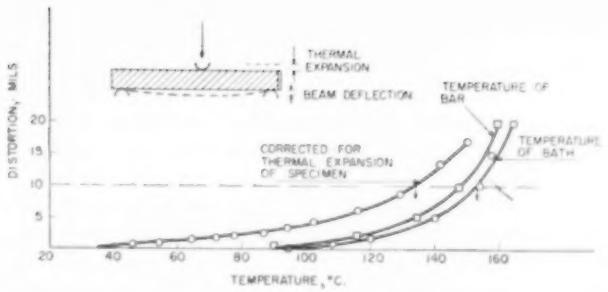


Fig. 14. Complete curves for an ASTM heat-distortion test on clear cast bars of Resin C. Inset (upper left) shows how thermal expansion of the specimen counteracts distortion.

A somewhat smaller correction lies in the thermal lag of the specimen behind the heating bath.

Figure 14 plots the distortion vs. temperature history of a bar of cast Resin C, and adds the corrections, however, for both thermal expansion and thermal lag. This particular experiment would be reported as the 154° C., heat-distortion point. With the corrections, however, the value becomes 134° C., or 20° less than the former figure. This conforms to the onset of plastic action in laminates at medium stress, (see Fig. 5.)

With thermoplastics that soften at comparatively low temperatures, the net temperature rise is small and the distortion large, so that thermal expansion effects are not as important. With cross-linked materials, the net rise of the specimen may be 100° C. higher and the distortion of the beam, when it comes, is slow and

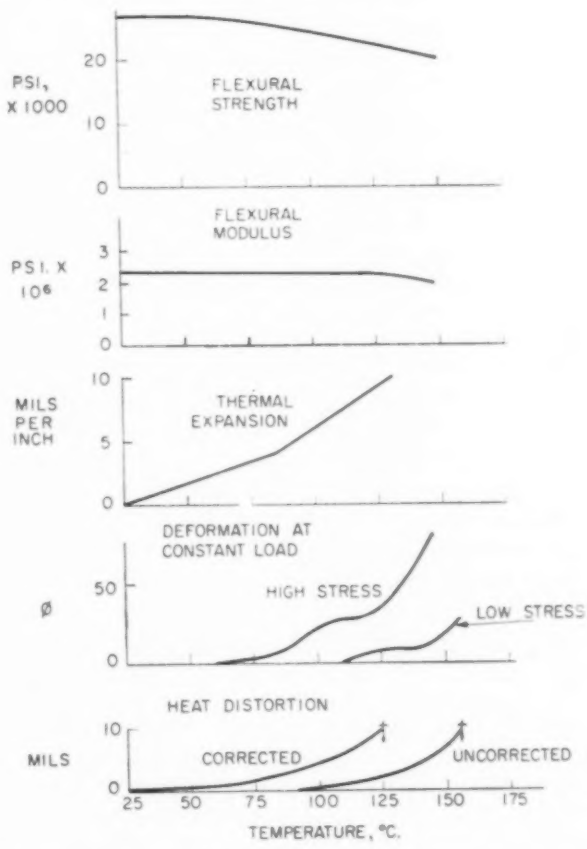


Fig. 15. Comparison of results with five experimental test methods to show effect of transition of Resin C between glassy and rubbery states.

gradual. The correction for thermal expansion, therefore, is substantial.

In general, softening points show a complicated time, stress, and temperature dependence and, therefore, any choice of measurement technique will be arbitrary to a certain degree. Even thermal expansion measurements made at negligible stress can be shown to depend on the rate of heating. However, the heat-distortion best introduces an additional complexity in that the dependent variable, deflection, is made to depend on two other experimental quantities (temperature and time) both of which are varied simultaneously.

It has been shown that the occurrence of transitions in laminates is a function of stress, and is difficult to observe at low stress. "Low stress" for a laminate still is considered to be above 1,000 psi. in bending, whereas heat-distortion measurements are made at 264 psi. Heat-distortion tests on laminates and reinforced-plastic samples commonly are quoted as being in excess of 200 of 250° C. Such a result is meaningless, and the difficulty lies in the use of a stress so low that the detection of an apparent transition point virtually is impossible in a reinforced-plastic specimen.

The intent of the heat-distortion test is to disclose if a temperature exists at which the decay of stiffness is so great as to limit its use at or above that temperature. Limiting temperatures do exist in reinforced plastics but with any given resin, are associated with stresses and reinforcements which play as important a part in the final result as does temperature.

Discussion Of Results

The tacit assumption has been made that the presence of reinforcement in a laminate may dominate the mechanical behavior of the laminate so that the rheology of the resin is masked effectively, except in tests of long duration. This work has shown that reinforced plastics show extensive rheology, and that the same deformation vs. temperature pattern may be shown to exist in laminates of widely varying reinforcements, provided appropriate stresses are used. Consequently, the concepts of polymer physics, may be more applicable to reinforced plastics than has been appreciated heretofore. Polymer physics theory has recognized three mechanisms whereby deformation of a resin may take place, as follows:

(1) Ordinary elasticity. This produces an instantaneous, recoverable deformation that is relatively independent of temperature. This is associated with the bending of valence bond angles.

(2) High or rubber-like elasticity. This produces recoverable deformation by a retarded response to stress that can be associated with the uncoiling of polymer chains. The modulus of high elasticity is considered to be independent of temperature. The relaxation time of the retarded response is a function of temperature, so that the rate of highly-elastic deformation is temperature-dependent.

(3) Viscous flow. This yields non-recoverable deformation at a rate proportional to stress, and has a very large dependence on temperature. This process is associated with slippage of polymer chains. Bond rupture also may be involved.

In this work, the over-all pattern observed can be generalized into somewhat similar phenomena, as follows:

(1) At low temperatures, deformation is rapid and recoverable, and only slightly temperature-dependent.

(2) At intermediate temperatures, instantaneous deformation is followed by retarded deformation. The recovery is rapid initially, and followed by a retarded response. The amount of deformation is greater than that seen in the low-temperature range, but is constant over an appreciable range of temperatures.

(3) At high temperatures, the deformation is both time- and temperature-dependent, and not entirely recoverable.

(4) The temperatures at which these effects become predominant are functions of stress.

These four categories of behavior show a striking similarity to those that would be expected from classical theory. Thus, the low-temperature behavior may be considered as governed by ordinary elasticity; the intermediate-temperature response may be considered as the development of high elasticity; and the results at high temperature may be taken as a manifestation of high elasticity and greatly reduced relaxation time, plus a contribution from viscous flow. It is not represented that these categories are firmly established, but it is suggested that the similarities are sufficiently striking to warrant further attention. Thus, the concepts and techniques of the polymer physicist may become of increasing importance to research workers in reinforced plastics.

This paper has been concerned with the response of a laminate when the resin goes through the transition between the "glassy" and "rubbery" states, and from the temperature range where ordinary elasticity dominates the properties to the temperatures that produce high elasticity. A number of methods have been discussed for observing these changes. To summarize the over-all work, Figure 15 is a summary chart in which flexural strength, flexural modulus, thermal expansion, heat distortion, and loss in stiffness have all been plotted as functions of temperature on a common temperature scale.

It is noted that flexural strength and flexural modulus determinations do not give evidence of transition phenomena. It is believed that the time scale of these tests is such as to obscure the retarded response to stress that is an important characteristic of materials in the rubbery state above the glass temperature. At high temperatures, the relaxation times become short enough so that the conventional modulus test picks up the lower elastic modulus associated with high elasticity.

Conclusions

The mechanical properties of a reinforced plastic

structure depend on whether the resin is in the "glassy" or "rubbery" state. Mechanisms of failure involve brittle fracture of the resin in the former, and time-retarded deformation of the resin in the latter.

Tests which measure deformation with time at constant load, and constant temperature are more useful in exploring these characteristics than are tests which load the sample continuously to failure.

The apparent temperature of transition is a function of stress on the resin. This stress may be varied by adding or subtracting load on the specimen, or by adding or subtracting reinforcement. Resins show a characteristic temperature- and stress-dependent rheology that may be duplicated in laminates made from them, provided appropriate stresses are used.

The ASTM heat distortion test is affected seriously by thermal expansion of the specimen. As presently constituted, the stress level is too low to give valid results on reinforced materials.

Acknowledgements

The author wishes to acknowledge the valuable assistance of C. J. Reynolds, and D. F. Hardesty for much of the experimental work; and L. Lazar for the thermal expansion measurements.

Bibliography

(1) Turner, Alfrey, Jr., "Mechanical Behavior of High Polymers," p. 77 and 120. Interscience Publishers, New York, N. Y. (1948.)

(2) H. Mark and A. V. Tobolsky, "Physical Chemistry of High Polymer Systems," p. 348, Interscience Publishers, New York, N. Y. (1950.)

(3) R. S. Spencer, "Rheological Properties of Polystyrene." In A. C. S. Monograph, "Styrene," Reinhold Publishing Corp., New York, N. Y. (1952.)

(4) B. B. Pusey, "Effect of Time, Temperature, and Environment on the Mechanical Properties of Reinforced Plastics." **Plastics Technology**, 2, 8, 528. (Aug. 1956.)

(5) J. J. Gouza and W. F. Bartoe, "Heat Distortion Temperature Measurements for Evaluation of Thermoplastics," **Ibid.**, 2, 2, 89. (Feb. 1956.)

(6) A. D. Coggeshall, "Polyester Resin Evaluation with Short-Time Flexural Creep Tests," **Ibid.**, 3, 1, 35. (Jan. 1957.)

—THE END

Reinforced Epoxy Spray Masks for Two-Tone Painting

(Continued from page 43)

Maintenance and Changes

It is important that the seal between the mask and shroud be absolutely tight along the paint dividing line. However, because of continual daily usage, the resin beads on the masks sometimes are chipped or broken (see Figure 7.) Such defects must be repaired or the paint will collect at those points and the spray gun will spread a fog of paint up to four inches wide on the concealed areas of the shroud that should be kept free of paint. We were well aware that such breaks could occur, and prepared for it by training an Outboard Marine worker in the proper repair methods.

To effect a repair, about one inch of the epoxy-based material on either side of the break is removed and the casting resin is trowelled on (see Figure 8.) For this, the paste edge-material is used. The resin compound sets overnight, and by the next day has hardened sufficiently to permit tooling to contour and dimension. Occasionally, a mask that has developed a nick or break must be returned to service in a matter of hours. To speed up such a repair, the epoxy resin is cured with heat lamps.

The reinforced epoxy masks also are advantageous when changes are made in design of the shrouds for new out-board motor models. To match such changes in specifications, the epoxy resin bead either can be removed or new material added. When metal masks were used in the past, they had to be scrapped following a design change, and new ones made. However, alterations in the shrouds usually are not made once they have been placed in production.

—THE END

Basic Research for the Plastic Industry

(Continued from page 45)

plan were lifted, and will be used to develop a model of a proposed "Plastics Institute."

How can such an institute accomplish the threefold goal of research, education, and dissemination of information? The needs are as broad as our industry, and as high as our hopes for the future. Certainly, the answers to such needs cannot be expected to come without hard work efficiently directed in an atmosphere of sincere support. The interest already shown in this preliminary planning has given visible evidence of the desire of our industry to get behind and develop an operation extensive enough to do the job. The organized groups representing the plastics industry have shown their active interest in such a venture. The actual physical operation of a Plastics Institute soon can become a reality when each member of the industry makes his investment in his own future.

—THE END

Plastic Pipe in the Chemical Process Industry

(Continued from page 50)

questions directed to typical resin producers or extruders will prove this point.

Some of the improvements that will be made on the job by engineers or maintenance men may sound fantastic in the light of present-day procedures. When engineers recognize the importance of the outstanding resistance of plastic pipe to corrosion, and the pipe's inherent physical properties, they will design composite structures having both exceptional strength and corrosion resistance.

The successful use of saran-lined pipe should justify consideration of the continuous on-the-job extrusion of thin plastic tubing within metal pipe. Likewise, the successful armoring of glass, porcelain, or impervious graphite pipe with epoxy resin-impregnated glass tape should indicate another important avenue for creativity. As mentioned previously, one type of fiberglass-reinforced plastic pipe that has been used successfully

(Continued on page 60)

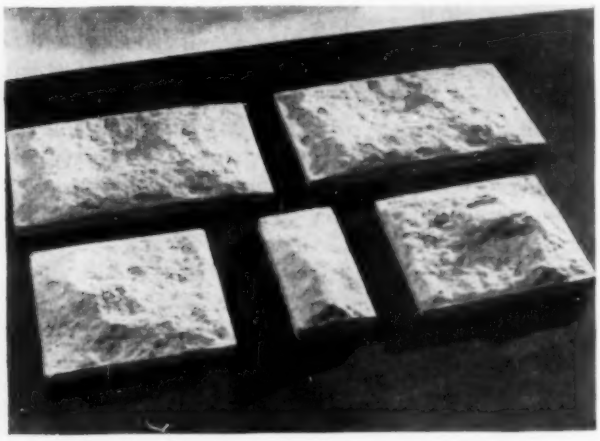
Plastic Solves Casting Problem

ROME Stone Corp. has come up with an unusual application for organosols—the fabrication of plastic molds for the casting of stone veneer. Using a formulation based on Goodyear's Pliovic vinyl resins, the company was able to produce molds which, in turn, were capable of reproducing the texture of hand-chiseled stone.

The plastic mold was found resistant to the water and chemicals contained in the stone mixture, and also was able to withstand the short, high-temperatures required during cure. Its flexibility facilitated post-cure stripping of the veneer from the mold. Mold lubricants were not required, and floor area needed for the production of Roman Stone was reduced 200% through the use of plastic forms. During cure, the filled molds are tiered from floor to ceiling. This was not possible with metal molds due to their excessive weight.

Roman Stone is designed for application over wood, stucco, wood siding, or concrete block. Application is said to require no special skill, and weight is only 8% that of quarried stone for a given surface area. Various stone colors and sizes are available.

—THE END



Some of the shapes available in Roman Stone.

House faced with Roman Stone.

Plastic Pipe in the Chemical Process Industry.

(*Continued from page 57*)

in the chemical industry is a composite structure in which all exposed surfaces are protected by vinyl resin.

When engineers become better acquainted with the versatility of the various kinds of plastic pipe, their success in solving problems will be unlimited. In the meantime, a knowledge of the outstanding resistance to corrosion and the inherent physical properties of the plastics will assure the successful use of plastic pipe in the chemical process industry.

Acknowledgments

In order to ascertain that the viewpoints expressed were up-to-date and representative of all available information, every known resin producer and extruder was asked to supply information for this report. An earnest attempt was made to use all information supplied.

The cooperation and assistance of the following is gratefully acknowledged: P. H. Collins, B. F. Goodrich Chemical Co.; C. L. Condit, Society of the Plastics Industry; G. Corfield, Southern California Gas Association; E. T. Darden, E. I. Du Pont De Nemours & Co., Inc.; C. B. De Ganahl, Spiral-Glass Co.; E. A. Erich, Tube Turns Plastic Inc.; H. A. Fedderson and P. A. March, both of Loven Chemical of California; O. H. Fenner, Monsanto Chemical Co.; L. J. Fitzharris, M. W. Kellogg Co.; W. E. Gloor, Hercules Powder Co.; R. N. Hampton, Dow Chemical Co.; H. H. Irwin, Marbon Chemical Co.; B. Kellam, Hydro-Electric Power Commission of Ontario; W. P. Moeller, Celanese Corp. of America; J. D. Powell, Naugatuck Chemical Div., U. S. Rubber Co.; R. P. Weyer, Carpenter Steel Co.; and T. M. Yeiser, Crescent Plastics, Inc.

—THE END

Moldmaking & Tooling

Moldmaker Apprenticeship Training

Edited by:
ERNEST J. CSASZAR, *Sales Engr.*
Newark Die Co.
Newark, N. J.

MY last article dealt with "Comments on Mold Costs," and emphasized that the main ingredient of mold cost is the labor involved in the actual mold construction. With this in view, let us examine the moldmaker who works on the bench and at specialized machinery, and whose hours of labor constitute the major portion of mold cost. This moldmaker is an individual with highly specialized skills built on a background of a thorough knowledge of machine shop practices and techniques. Many of today's qualified moldmakers have gained their knowledge merely through being exposed to moldmaking practices in moldmaking shops. More often than not, this knowledge was acquired without the benefit of a formal training program.

These statements are not meant as a reflection on the abilities of these people. We might consider it, perhaps, as a tribute to them for "doing it the hard way." Unfortunately, this type of activity does not always provide the greatest monetary yield for either the employee or employer. In short, in an enterprise where labor is a major cost item, and where this labor is of a highly skilled and specialized nature, a formal training program for replacements and expansions is certainly in order. The art of moldmaking fits these conditions most assuredly.

Both the present existence and the future growth of the moldmaking industry are dependent on the new crop of moldmakers being presently trained in one form or another. If we are to gain the greatest yield from these apprentices, their training program deserves the most careful attention. Unfortunately, many of the existing moldmaking shops are what we might term "small businesses." These smaller shops feel they cannot afford the luxury of a planned apprentice training program. In other cases, some employers fear the loss of trained employees to other shops who can afford to pay a little more to a trained person, since they themselves did not have to bear the costs of training.

No one can say these fears are totally unjustified, or that the costs of training are insignificant. However, I would rather minimize these negative aspects and point up the advantages.

With the recent developments in molding techniques and new materials, it is safe to say that the near future will bring many new plastics applications. These new plastics applications, coupled with the present requirements, will greatly increase the demand for tooling and molds.

Who will build these additional molds required? These molds will be built by the mold shops who are prepared to expand their facilities to meet the increased demand. The purchase of additional equipment, alone does not constitute expansion. Additional trained manpower will be needed to operate the new equipment. Those shops with formal training programs certainly will be in a better position than those without the programs.

It would be an additional advantage if a Moldmaker Apprentice Training Program could be more or less universal throughout the moldmaking industry. In this respect, I am happy to say, considerable progress has been made. In the very near future, the Moldmakers Division of the Society of the Plastics Industry will distribute to its moldmaker members a suggested Apprentice Training Program. The program has been designed for flexibility so that different shops can adjust the plan to suit their particular size and activity. It is hoped that many of the shops that do not have formal training programs will be encouraged to adopt part or all of this plan that was designed by moldmakers for the specific use of moldmakers.

—THE END

Edited by:
HARRY T. DOUGLAS
Executive Vice President
Lunn Laminates, Inc.
Huntington Station, N. Y.

Reinforced Plastics

Reinforced Plastics in Outer Space

DR. Werner Von Braun, America's ace rocket scientist, pointed out in a recent documentary Army film that fiber glass as a reinforcing material may well be used in our attempts to establish a station in outer space. While Dr. Von Braun specifically made reference to fiber glass as a reinforcement for rubber in space suits, it is interesting to conjecture our possible future uses for reinforced plastics in the construction of these way stations to the moon.

And why not? Today, reinforced plastics has pushed forward into a myriad of applications which to us in the industry would have been considered "out of this world" 10 years ago. Submarine fairwaters, huge Geodesic domes, sports cars, trucks, and radio and TV cabinets of reinforced plastics were dreamed of long ago, but now are realities.

It occurs to me that the extensive use of reinforced plastics in the construction of satellites may be decidedly advantageous. The popular concept of a space station seems to be a wheel-like structure, revolving upon an axis to develop its own gravity. Such a structure, because of its compound curvatures, seems to be a natural for reinforced plastics. From a tooling standpoint, comparatively low-cost molds could be used to produce the various sections.

The light weight and high strength of reinforced plastics could be of great advantage in delivering the pre-manufactured segments to the space station. It would be possible for rockets to deliver larger payloads with a given amount of propelling power. Perhaps the sections of the satellites, by clever design, might be used originally to form an inner liner to the cargo rocket. Then upon arrival at its destination, the rocket body could be disassembled and re-assembled in different order to form the shell of the space station.

Assuming a double-wall construction, utilizing honeycomb or foam, an added advantage may be gained from the insulation qualities of such construction, particularly by the cargo rocket enroute to the space station.

The inclusion of translucent panel sections could result in utilizing "starshine" as much as possible for illumination, at least as an aid to conserve power normally needed for lighting.

A further advantage could be gained from the fact that by proper design, portions of the station could utilize the outer shell as a radome without external bulges or fairings because of the ability of reinforced plastics to pass radar signals.

Dr. Von Braun pointed out the necessity for a shield for the space station to intercept impinging particles of various magnitudes which zip through space at great speeds. Could not the excellent energy-absorbing qualities of reinforced plastics also help here? The shield or umbrella then would be transparent to radar signals eliminating blind spots which would be covered by using shields of steel or aluminum.

With the eyes of the entire world constantly searching the heavens for Sputniks, missiles, and satellites of all descriptions, I, for one, would be proud to know that reinforced plastics helped recapture some of our development initiative.

—THE END

Compression & Transfer Molding

Edited by:
J. B. LIDSTONE*
Sales & Product Planning,
Chemical Materials Dept.,
General Electric Company
Schenectady, N. Y.

The Outlook for 1958

What is on tap for the compression moder in 1958? The economists see 1958 much like 1957, with perhaps a moderate business increase. The forecast for thermosetting plastics molding is moderate; however, as always, there will be new requirements, new measurements, new markets, new materials and new methods. The compression molder who taps these advances in the plastics field will be able to realize his own forecast. Let's cite some 1958 possibilities.

New Requirements

Molded parts will have to be smaller and yet last longer in high-temperature areas. Parts will have to be lighter and yet stronger. These new requirements will be demanded by the electronic, automotive, aircraft, communications, weapons, and allied industries served by the compression molder. These are results of clearly defined trends toward miniaturization and high-temperature operation.

New Markets

One exciting new area for contribution by the compression molder is the vast market (estimated at $20-million) for printed circuitry. Preliminary reports indicate that the combination of materials, methods, and technology in the compression shop can produce better, lower cost circuitry. Aggressive, selective, end-use selling by molders and material suppliers undoubtedy will expose other areas.

New Materials

In 1958, the compression molder will have the opportunity to work with a group of challenging new materials: high dielectric-strength phenolics that will challenge alkyds; higher impact-strength sisal compounds of good moldability; colored thermosets available broadly; and alkyd and polyester premix materials. Some new materials available to compression molders will combine the properties of yesterday's special-purpose products; for example, the combination of arc resistance, heat resistance, and strength in one product.

New Methods

Expanding technology will produce faster compression cycles in 1958, and the faster preheating materials to make the cycles pay off. Foreseen are high-productivity molding presses, and the production of extruded shapes of thermosetting materials.

New Measurements

The year 1958 will see growing awareness by the material supplier, the molder, and the end-user of the need for new and more meaningful measurements of properties of materials and molded parts. The technical data sheet of the future should include:

(1) A meaningful plasticity value to provide a sounder basis for tool design and material performance;

(2) An Erosion Ratio to allow selection by the molder of the material with a balance of properties;

(3) A Tool Wear Index (TWI) to assure optimum finishing methods; and

(4) A Standard Dimensional Stability Rating for the design of devices for utilizing tighter tolerances in thermosetting molded parts.

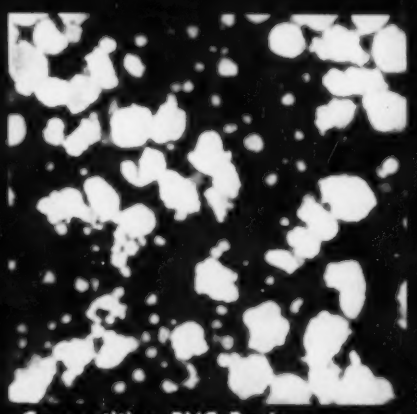
More relevant physical and electrical measurements will be required. Examples here are a standard-use impact test, and a more definitive arc-resistance test. The need extends to all thermosetting plastic materials.

These advances will take place through the cooperative effort of the molders, the material manufacturers, the end-users, the technical societies, and the technical journals. These advances will come about because we in the industry make them happen. These advances will provide opportunity for profit that must be kept within the plastics industry to strengthen and expand it.

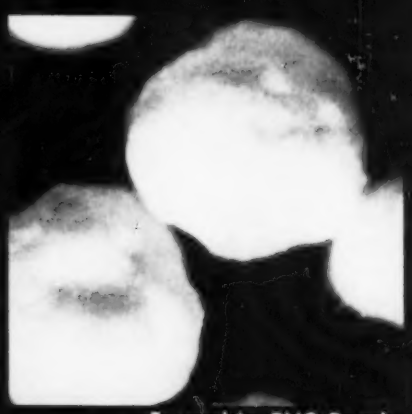
*This column replaces John H. Woodruff's Forum this month.

—THE END

Announcing...



Competitive PVC Resin



Escambia PVC Pearls

(Each Magnified 40 times)

ESCAMBIA PVC *Pearls*

THIS RADICALLY *new* PVC POLYMER . . . brings you the following advantages for better products —

Complete freedom from "fines" . . . Extremely high plasticizer absorption rate . . . Unusually low gel count . . . Excellent heat stability . . . Available in four molecular weights.

For samples and additional information on this completely new PVC . . . write or call —

ESCAMBIA CHEMICAL CORPORATION

261 MADISON AVENUE • NEW YORK 16, N. Y.

News of the Societies

Advance Program of SPE Annual Conference

The Society of Plastics Engineers, Inc., has announced the advance program for its fourteenth annual National Technical Conference, to be held at the Hotel Sheraton Cadillac, Detroit, Mich., on January 28-31, 1958. The presentation of 26 major topics will encompass more than 100 technical papers.

The advance program for the various sessions is given below:

Tuesday Morning, January 28

Radiation and Plastics—I: moderator, W. E. Gloor, Hercules Powder Co.

"Radioisotopes and Plastics" Paul C. Aebersold, U. S. Atomic Energy Commission.

"Accomplishments in Plastics Applications with Radiation-United States and Abroad," J. R. Stirrat, A. Miller, and E. Lawton, General Electric Co.

"The Role of Atomic Radiation in Plastics Science and Technology," R. F. Boyer and Robert McFedries, The Dow Chemical Co.

Tuesday Afternoon, January 28

Radiation and Plastics—II: moderator, R. F. Boyer, The Dow Chemical Co.

"Ionizing Radiation," A. John Gale, High Voltage Engineering Corp.

"Operation of a Radiation Facility," J. W. Ranftl, General Electric Co.

"Practical Problems in Radiation Curing," R. G. Bauman, The B. F. Goodrich Co.

"Graft Copolymerization on Polyethylene," H. G. Hammon, Battelle Memorial Institute.

Epoxy Resins and Embedment session; moderator C. A. Harper, Westinghouse Electric Corp.

"Characteristics of Flexible Epoxy Resins," H. C. Classen, Jones-Dabney Co.

"Strain Gauge Evaluation of Casting Resins," R. N. Sampson, Westinghouse Electric Corp.

"Material Handlings of Epoxy and Polyester Resins," W. A. Gammel, Sr., R-B-M Division, Essex Wire Corp.

"Heat Resistant Epoxy Resin Systems," J. E. Carey and F. C. Hopper, Shell Chemical Corp.

Extrusion-I; moderator, A. A. Kaufman, Prodex Corp.

"Extrusion Theory," L. F. Street, Welding Engineers Co.; Hugh M. Hulbert and Stanley Katz, American Cyanamid Co.

"Beta Gauge Measurement and Control of Plastic Thickness and Area Weight," G. L. Doering, Industrial Nucleonics Co.

"Estimating the Drag-Flow Efficiency of Extruder Screws," P. H. Squires, E. I. du Pont de Nemours & Co.

"Power and Heat Energy Relations in Polyethylene Extrusion," B. H. Maddock, Bakelite Co.

Injection Molding-I; moderator, William J. Gobeille, American Motors Corp.

"Injection Molding of Large Sections," M. Silovich, Evart Products Co.

"Conical Heat Chamber," R. T. Wheeler, Crown Cork & Seal Co.

"Preplastification for Injection Molding," E. Gaspar and M. G. Munns, The Projectile & Engineering Co., England.

"Forming of Aerosol Containers of 'Zytel' Nylon Resin," J. B. Patton, R. M. Bonner and W. E. Ebeling, E. I. du Pont de Nemours & Co.

Tuesday Evening, January 28

Educational Symposium; moderator, R. C. Bartlett, Natvar Corp. The theme will be sponsored research in plastics and a panel discussion will reveal the points of view of industry, government, universities, and research institutes.

Wednesday Morning, January 29

Packaging; moderator, M. J. deVietien, Paper Package Co.

"The Properties of Linear Polyethylene Pertinent to the Packaging Industry," L. F. Swec, W. R. Grace & Co.

"Health Safety of Plastics in Food Packaging and Housewares," D. D. McCollister and W. J. Sauber, The Dow Chemical Co.

"End-Use Correlation of Styrene Container Testing," B. Nathanson, Monsanto Chemical Co.

"Oriented Polystyrene Film," F. C. Dulmage, The Dow Chemical Co.

Plastic Tooling; moderator, F. Lyijnen, Chrysler Corp.

"Plastics as Used for Tooling Aids in the Stamping Industry," E. Ruddiman, Ford Motor Co.

"Plastic Tooling in the Aircraft Industry," R. H. Voss, Warren Plastics & Engineering Co.

"Plastics, an Aid to the Cast Metals Industry," W. R. Weaver, Modern Pattern & Plastics Co.

"Plastic in the Metal Working Industry," G. E. Rice, Ren Plastics, Inc.

Mold Design; moderator, L. J. Morrison, Detroit Mold Engineering Co.

"Machining Practices in Mold Making," E. J. Krabacher, and P. A. Ropp, Cincinnati Milling Machine Co.

"Reducing Mold Costs and Improving Quality Through Planning Methods," William D. Evans.

"The Theory and Study of Latest Techniques of Mold Design for Linear Polymers and Other Thermoplastic Materials," A. Spaak, W. R. Grace & Co.

"Mold Polishing," A. W. Logozzo, Nutmeg Chrome Corp.

New Materials-I; moderator, E. L. Kropscott, The Dow Chemical Co.

"Practical Methods for Fabrication Using Polyethylene Sheets, Rods and Tubes," Dr. Rottner, Farbwerke Hoechst, Germany (to be read by W. Paul Acton, Hercules Powder Co.)

"Molding Characteristics of Diallyl Phthalate Compounds," L. B. Keller, W. R. McGlone and D. H. Wodin, Hughes Aircraft Co.

"Lexan Polycarbonate Resin—A New High Strength, Heat Resistant Plastic," W. F. Christopher, General Electric Co.

"Application of Larson-Miller Correlation to Service Test Data on High Density Polyethylene," W. E. Gloor, Hercules Powder Co.

Wednesday Afternoon January 29

Test Methods; moderator, F. W. Reinhart, National Bureau of Standards.

"Measuring Gas Transmission Performance of Plastic Films," W. E. Brown and W. J. Sauber, The Dow Chemical Co.

"Friction and Abrasion Characteristics of Plastic Materials," Mario Marcucci, Minneapolis-Honeywell Regulator Co.

"Applications of the Tensile Impact Test," M. S. Nutkis, Bakelite Co.

"Evaluating Plastics for Compression Molding Phonograph Records by Use of a Capillary Extrusion Rheometer," W. E. Coleman, Monsanto Chemical Co.

Injection Molding-II; moderator, M. G. Sherwood, Michigan Plastic Products.

"Effect of Processing Conditions Upon Density of Linear Polyethylene," J. P. Fogerty and E. Poindexter, W. R. Grace & Co.

"New Techniques in Injection Molding of Linear-Type Polyethylene," D. A. Jones, Celanese Corp. of America.

"Better Operation with Better Plant Layout," R. L. Beesley and D. B. Semyn, The Dow Chemical Co.

"Molded Shrinkage and Dimensional Stability of Nylon 6," J. M. Verdi and R. F. Flaherty, Allied Chemical & Dye Corp.

Reinforced Plastics; moderator, M. J. Petretti, Camfield Fiberglas Plastics, Inc.

"Effects of Elevated Temperature and Erosion on Reinforced Plastic Laminates," N. B. Miller and E. L. Strauss, The Martin Co.

"Development of Steam Resistant Fiberglas Rinforced Plastics," E. G. Bobalek, Cass Institute of Technology, W. Ellslager, Glidden Co., and T. Harris Structural Fibers, Inc.

"Fabrication of Reinforced Plastics Made from Acrylic Sirup," Brian Mead Jr., J. A. Ross and J. T. Rundquist, E. I. du Pont de Nemours & Co.

"A Discussion of Polyester Premix," W. O. Erickson, Allied Chemical & Dye Corp.

Extrusion-II; moderator, W. E. Jacobson, Yardley Plastics Co.

"Effect of Extrusion Conditions of Strength of Polyethylene Pipe," J. F. Morris, Spencer Chemical Co.

"Rigid Polyethylene Pipe," L. B. Croley

and Robert Doyle, Phillips Chemical Co.

"Polyethylene Monofilaments," J. F. Groel and J. H. Versteeg, Bakelite Co.

"Extrusion and Vacuum Forming of High Density Polyethylene Sheet," J. G. Farrow and G. H. Sollenberger, Koppers Co., Inc.

Thursday Morning, January 30

New Materials-II; moderator, J. A. Clark, General American Transportation Corp. "Properties of High Temperature Epoxy Systems," L. S. Buchoff and W. R. Sherwin, Westinghouse Electric Corp.

"European Progress in Plastics," Zoltan Merszei, Dow Chemical International, Ltd.

"Properties and Applications of a New Low Viscosity, Solventless, Thermosetting Silicone Resin," M. E. Nelson, Dow Corning Corp.

" 'Delrin' Acetal Resin—A New Thermoplastic. Properties, Fabrication and End-Use Testing," R. J. Manning, R. H. Hardesty and J. F. Cogdell, E. I. du Pont de Nemours & Co.

Aumotive Applications; moderator, J. T. O-Reilly, Ford Motor Co.

"General Review of Automotive Applications for Plastics," E. J. Storfer, Chrysler Corp.

"Reinforced Plastics in the Automobile," J. G. Coffin, Chevrolet—St. Louis.

"Polyurethane Foam in the Automotive Industry," M. J. Sanger, General Tire & Rubber Co.

"Plastics in Automotive Trim," R. McCullough, Ford Motor Co.

Color and Finishing; moderator, C. F. Massopust, General American Transportation Corp.

"Coloring by the Molder," J. E. Simpson, Ferro Corp.

"Recent Developments on Finishes and Application Techniques for Vacuum Metallizing Plastics," M. A. Self, Logo, Inc.

"Hot Leaf Stamping," M. A. Olsen, Olsenmark Corp.

"Coloring Methods for Marlex 50 Polyethylene," J. N. Scott and J. V. Smith, Phillips Chemical Co.

Mold Design-II; moderator, E. C. Fries, Auburn Plastics, Inc.

"Mold Cost as Affected by New Metal Casting Methods," J. A. Kavanagh, Standard Tool Co.

"Practical Design for Hot Runner Molding," J. R. Gerner, Protective Closures Co., Inc.

"The Use of Heat Resistant Epoxy Formulation for Producing Low Cost Molds for the Plastics Industry," R. T. O'Connor, Devcon Corp.

"Tooling Cavities for Quality Class Commercial II Plastic Gears," J. R. Venne, International Business Machines Corp.

Thursday Afternoon, January 30

Potpourri; moderator, A. A. Pavlic, E. I. du Pont de Nemours & Co.

"Publicity is Not Free," L. R. Greif, Greif-Associates, Inc.

"Printed Wiring Processing," E. B. Murphy, Massachusetts Institute of Technology.

"Methods of Joining Plastic Parts," A. J. Cheney and W. E. Ebeling, E. I. du Pont de Nemours & Co.

"Plastic Research and Development: Fact or Fancy from a Manager's Viewpoint," R. M. Houghton, Houghton Laboratories, Inc.

Extrusion-III; moderator, C. N. Sprankle Plax Corp.

"The Extrusion of Polyethylene Film with Controlled Properties by the Flat Film Process," H. B. Robinson, Jr., and W. A. Haine, Bakelite Co.

"Polyvinyl Dry Blend Extrusion in the Wire Coating Field," E. H. Hankey, Monsanto Chemical Co.

"Nylon 6 Tubing-Extrusion Techniques and Effects of Environmental and Processing Conditions on Strength," J. L. O'Toole, H. G. Tinger, and T. R. von Toerne, Allied Chemical & Dye Corp.

"Teflon 100-X Perfluorocarbon Resin—A New, Melt-Extrudable Fluorocarbon Resin," R. S. Mallouk, E. I. du Pont de Nemours & Co.

Injection Molding-III; moderator, D. R. Fegley, Reed-Prentice Corp.

"Maintenance Program for the Molding Industry," James C. Engman.

"Wiring Diagrams—Their Purpose and How to Understand Them," F. R. Cinco, Reed-Prentice Corp.

"Automatic Injection Molding," Q. M. White, F. J. Stokes Corp.

"Injection Molding by Automatic Means at Kodak," L. Ulmschneider, Eastman Kodak Co.

Foams; moderator, R. H. Kittner, Mobay Chemical Co.

"New Developments in Vinyl Foam," F. T. Scott, Bakelite Co.

"Properties of Urethane Foams," J. H. Saunders, Mobay Chemical Co.

"New Room Temperature Setting, Heat Resistant, Low Density Silicone Foams," D. E. Weyer, Dow Corning Corp.

"Epoxy Resin Foams," M. H. Nickerson, DeBell & Richardson, Inc.

Friday Morning, January 31

Compression Molding; moderator, S. H. Greenwood, F. J. Stokes Corp.

"Compression and Transfer Molding of Epoxy Compounds," W. J. Dewar, Furane Plastics, Inc.

"Automatic Preforming of High Impact Phenolic Materials," M. E. Lawrence, Logan Hydraulics Inc.

"Properties Required for Automatic Compression Molding of Thermosetting Materials," F. J. Donohue, Monsanto Chemical Co.

"The Development and Application of Automatic Preheating of Thermosetting Powders," D. C. Amsler, Pass & Seymour, Inc.

Sheet Forming; moderator, D. A. Davis, General Electric Co.

"Technical Aspects of Postformable Decorative Laminates," A. V. Dupuis, Monsanto Chemical Co.

"Theoretical Aspects of Vacuum Forming Thermoplastic Materials," Leopold Dreifuss, Hydro-Chemie, Ltd., Switzerland.

"Extrusion and Vacuum Forming of Polyethylene Sheet," A. L. Griff, H. F. Tomfohrde III, and E. E. Griesser, Bakelite Co.

"Advancements in Continuous Vacuum Forming Processes," M. J. Kalahar, Kal Plastics, Inc.

New Materials-III; moderator, W. O. Bracken, Hercules Powder Co.

"Embrittlement of Polyethylene," C. S. Imig, Spencer Chemical Co.

"Environmental Stree-Cracking of Polyethylene Injection Moldings—Practical Control and Test Methods," S. R. Melvin, Monsanto Chemical Co.

"Some Tensile Properties of Fractionated Low-Pressure Polyethylene," L. H. Tung, The Dow Chemical Co.

"Early Detection of Weathering Damage in Polyethylene," J. W. Tamblyn, G. C. Newland, and M. T. Watson, Tennessee Eastman Co.

Rheology; moderator, E. A. Haddad, Monsanto Chemical Co.

"Historical Introduction to the Rheology of Plastics," E. T. Severs, Natvar Corp.

"Rheology of Intensive Mixing—I," J. T. Bergen, Armstrong Cork Co., G. F. Carrier and J. A. Krumhansl, Brown University.

"Rheology of Intensive Mixing—II, Flow in an Intensive Mixer," William R. Bolen and R. E. Colwell, Monsanto Chemical Co.

"Rheological Considerations in Plastics Product Design," Bryce Maxwell, Princeton University.

SPI's Reinforced Plastics Division Holds 13th Annual Conference

SPI's reinforced plastics division has announced the program for its 13th annual conference to be held February 4-6 at the Edgewater Beach Hotel, Chicago, Ill. By scheduling concurrent sessions, nearly 80 technical, engineering, and management papers will be presented. A detailed program for the three-day conclave follows:

Tuesday morning, February 4

Session 1—Materials Survey. Presiding, Thomas J. Jordan, General Electric Co.

"Survey—Resin Developments," J. Bjorksten, Bjorksten Research Laboratories, Inc.

"Evaluation of Organic Peroxides on the Basis of Half-Life Data," D. F. Doehnert and O. L. Mageli, Wallace & Tiernan, Inc.

"Functional Inorganics for Use as Reinforced Plastic Fillers," S. R. Mountsier, Jr., and Miss A. J. Gitter, Whittaker, Clark & Daniels, Inc.

"Properties of Reinforced Plastics Made from Acrylic Sirup," M. S. Ziegler, W. A. Calkins, and W. M. Edwards, E. I. du Pont de Nemours & Co., Inc.

"Optimum Aromatic-Amine Hardened Epoxy-Glass Laminates," H. Raech, Jr., Northrop Aircraft, Inc., and F. F. Harris, Grand Central Rocket Co.

Session 2—Strength Time Behaviour of Reinforced Plastics. Presiding, H. R. Nara, Case Institute of Technology.

"Physical Properties of Prepreg Laminates," Grant Brown, Cordo Chemical Corp.

"Dielectric Measurements for Process and Product Evaluation," J. J. Knudsen,

Delsen Corp.

"Improvement of Reinforced Plastics by Fibers from New Glasses," J. W. Case, Dep't of the Navy; Albert Lasday, J. F. Brossy, and Armand Houze, Houze Glass Corp.

"Mechanical Properties of Glass Reinforced Casting Resins," C. L. Segal, Hughes Aircraft Co.

"Glass Fabric-Base Laminate Physical Properties as a Function of Finishing Variables," R. C. Horton and H. S. Falls, J. P. Stevens & Co., Inc.

"Tensile Strength of Glass Fibers, J. A. Kies, Naval Research Laboratory, and R. E McVicker, Bureau of Aeronautics.

"An Investigation of the Optical Properties of Fiberglass Reinforced Translucent Panels," J. B. Crenshaw and D. Smith, Interchemical Corp.

Session 3—Quality Control. Presiding, A. E. Raeuber, Southern Research Institute.

"'Controlled Process' Fabrics from Controlled Weight-Length Variation Yarns," W. J. Eakins, DeBell & Richardson, Inc.

"Bond of Resin to Glass," A. C. Anderson and J. H. Healy, A. O. Smith Corp.

"Proposed NOL Ring Test Method for Parallel Glass Roving Reinforced Plastics: Evaluation of Chemical Finishes," P. W. Erickson, I. Silver, and H. A. Perry, Jr., U.S. Naval Ordnance Laboratory.

"Quality Control for Glass Fiber Reinforced Translucent Panels," G. R. Huisman, Filon Plastics Corp.

"Reliable Properties Can Be Guranteed Despite Many Cantankerous Variables," R. S. Jackson, The Glastic Corp.

Session 4—Presiding, George L. Smead, L-O-F Glass Fibers.

"The Meaning of ISO Activity to the Reinforced Plastics Industry," G. M. Kline, National Bureau of Standards.

"What the reinforced Plastics Industry Needs," R. S. Morrison, Molded Fiber Glass Co.

Tuesday Afternoon, February 4

Session 5—Strength-time Behaviour of Reinforced Plastics. Presiding, J. W. Case, U.S. Dep't of the Navy

"Long-Term Rupture Strength in Glass Reinforced Plastics," S. Goldfein, U.S. Army Engineer Research & Development Laboratories.

"Unidirectional Glass Reinforced Plastic Ring Structures," N. Chessin, General Electric Co.

"Creep Characteristics of Laminates Epoxy Plastics," J. Delmonte, Furane Plastics, Inc.

"Laminates Reinforced with Asbestos," N. E. Wahl and H. M. Preston, Cornell Aeronautical Laboratory, Inc.

Session 6—Reinforced Plastics Building Materials. Presiding, F. J. McGarry, Massachusetts Institute of Technology.

"Structural Sandwich Panels in Building Applications," A. N. Williams, Haskelite Mfg. Corp.

"Some Factors Influencing Durability of Glass Reinforced Laminates," A. L. Smith and J. R. Lowry, Rohm & Haas Co.

"The Monsanto Inorganic Research Laboratory Building," M. F. Gigliotti, Monsanto Chemical Co.

"Building Codes as Applied to Reinforced Plastics Building Materials," F. X. Ambrose, Alsynite Co. of America.

"The Brussels Exhibition—The World's Largest Plastic Structure," A. G. H. Dietz, Massachusetts Institute of Technology.

Session 7—Industrial Design. Presiding, J. M. Little, J. M. Little & Associates.

"Seats, Sides, and Suitcases," J. W. Hauser and D. W. Hawley, Jon W. Hauser, Inc.

"The Application of Reinforced Plastics to Transportation Uses," A. Cripe, Chesapeake & Ohio Ry.

"Reinforced Plastics in Architectural Applications," A. Forte, Holabird, Root & Burgee, Architects.

Tuesday Evening, February 4

Session 8—Strength-time Behaviour of Reinforced Plastics. Presiding, L. S. Lazar, General Electric Co.

"Effects of High Intensity Thermal Radiation on Plastic Laminates," H. S. Schwartz and B. J. Lisle, Wright Air Development Center.

"Effects of Elevated Temperature and Erosion on Reinforced Plastic Laminates," N. B. Miller and E. L. Strauss, The Martin Co.

"Radome Materials for Operating Temperatures Above 500° F.," P. G. Swanson and Francis Bozzacco, Goodyear Aircraft Corp.

"The Behaviour of Reinforced Plastics at Very High Temperatures," L. H. Schenker and I. J. Gruntfest, General Electric Co.

"Subsonic and Supersonic Rain Erosion," G. P. Peterson, Wright Air Development Center.

Session 9—Premix Molding and Compounding. Presiding, J. L. Harvey, Consultant.

"A Comparison of Phenolic and Polyester Premix Materials," J. J. Colao and M. M. Gurvitch, Allied Chemical & Dye Corp.

"Report of the Premix Standards Committee," Lawrence Wittman, Lawrence Wittman & Co.

"Physical Properties of Transfer and Compression Molded Premix Materials," R. H. Calderwood and H. R. Sheppard, Westinghouse Electric Corp.

"Applications and Suggested Uses of Polyester Premixes," C. W. Proudfitt, Celanese Corp. of America.

"A New High Strength Molding Material," S. G. Salzinger and H. M. Toellner, Coast Mfg. & Supply Co.

Session 10—Preforming. Presiding, A. J. Wiltshire, White Sewing Machine Corp.

"Automatic Preforming Equipment," C. D. Jones, Structurlite Plastics Corp.

"A Product History of Preforming Without Discoloration," R. E. Mollman, Plastic Products Corp.

"Mold Design to Compensate for Warpage in Reinforced Plastics Parts," T. Harris, Structural Fibers, Inc.

"Technical Features of the Rotary Roving Cutter Using Carbide Blades," L. E. Swanson, Turner Machine Co., Inc.

"The Pressurform Process of Preforming," S. H. A. Young, Pressurform Container Corp.

Wednesday Morning, February 5

Session 11—Research Symposium. Presiding, W. B. Wilkins, Consulting Engineer.

"Fundamental Studies of Adhesion," J. J. Bikerman, Massachusetts Institute of Technology.

"Resin-Glass Bond Characteristics," F. J. McGarry, Massachusetts Institute of Technology.

"Behaviour of Fibrous Glass Laminates from Interior Strain Measurements," R. E. Chambers, Massachusetts Institute of Technology.

"The Effect of Polyester Resin and Process Variables on Laminate Properties," W. G. Carson and A. L. Smith, Rohm & Haas Co.

"Design and Operation of a Rosette Extensometer," A. G. H. Dietz and F. J. McGarry, Massachusetts Institute of Technology.

Session 12—Processing—East Lounge, presiding P. R. Young, Wallace & Tiernan, Inc.

"Vacuum-Pressure Injection Molding of a Reinforced Plastic, Helicopter Contravane," K. A. Schneider, United Aircraft Corp.

"Simultaneous Deposition of Fiberglass and Resin as a Manufacturing Technique," D. F. Anderson, Rand Development Corp.

"Development of a Reinforced Plastic Jato Motor," J. J. Scavuzzo, Picatinny Arsenal.

"Reinforced Plastic Bathtub Fabrication Methods," C. H. Van Hartesveldt, Sterling Precision Corp.

"Asbestos Reinforced Plastics Motor for Vanguard Rocket Components," E. G. Dingman, The Martin Co.

"Contour Weaving of Reinforcement," A. R. Campman and E. Koppelman, Raymond De Icer & Engineering Co.

Session 13—Plastics Tooling. Presiding F. Lyijynen, Chrysler Corp.

"Cure Shrinkage of Epoxy Resin Systems," H. L. Parry and H. A. McKay, Shell Chemical Corp.

"Mold Making by Electroforming," S. Fialkoff, Camin Laboratories, Inc.

"New Fiber Reinforced Epoxy Compositions," A. P. Mazzucchelli, Union Carbide Corp.

Thursday Morning, February 6

Session 14—Management. Presiding, A. W. Levenhagen, Molded Fiber Glass Tray Co.

"Accounting — History or Working Tool?" W. H. Nussbaum, Consultant in Accounting.

"Advertising and Public Relations," C. H. Sapper, Lando Advertising Agency.

"Getting Team Unity in the Growing Corporation—A Case Study," R. B. White,

"Market Research for Reinforced Plastics," J. B. Durra, J. B. Durra & Co.

"Reinforced Plastic Transportation Equipment: A Bright Future," K. C. Sanders, The Heil Co.

Session 15—Filament Winding. Presiding, S. Z. Oleesky, Zenith Plastics Co.

"Filament Wound Metal Composite Vessels," R. J. Noland, Reinhold Engineering & Plastics Co.

"Development of Improved Filament-Wound Pressure Vessels," G. Epstein and H. A. King, Aerojet-General Corp.

"The History and Potential of Filament-Winding," R. E. Young, Young Development Laboratories, Inc.

"Filament-Winding Developments for Rocket Applications," R. Gorcey, North American Aviation, Inc.

Session 16—Boat Construction. Presiding, H. L. Darby, Winner Manufacturing Co., Inc.

"Design and Development of an Outboard Runabout Boat," E. F. Culwick, Winner Manufacturing Co., and D. Savitsky, Stevens Institute of Technology.

"Boat Styling—A Reflection of the Times," J. D. Beinert, Member, American Society of Industrial Designers.

"Plastic Boats in the United States Navy," C. L. Fears and H. Shek, Dep't of the Navy.

"Reinforced Plastics as Protective Coatings for Wood," R. Mark, Balsa Ecuador Lumber Corp., and B. M. Zuckerman, Wood Products Pathologist and Consultant.

"Evaluation of Laminate Construction for Boats," L. D. Moore and P. P. Lahde, Ferro Corp.

Session 17—Luncheon.

Thursday Afternoon, February 6

Session 18—Open Forum. Presiding, R. J. Brinkema, Firmaline Products, Inc. During this session, questions may be posed to authors of papers delivered at the conference.

Personal Contact periods will be held on the afternoon of February 5, and will be followed by a reception and the annual banquet.

English Polymer Conference

A conference on "Recent Advances in Polymer Technology" is being sponsored jointly by the British Institution of the Rubber Industry and the Plastics Institute. The date is February 27, and the site is the Institution of Civil Engineers, Great George St., Westminster.

Papers and speakers are as follow: "Recent Advances in Polymerization Techniques," H. W. Melville, Dept. of Scientific & Industrial Research; "Masterbatching Techniques," H. A. Braendlo, Columbian Carbon Co.; "Preplasticizing Methods," R. Schooley, R. H. Windsor, Ltd.; "Rubber-Resin Combinations," speaker from Institut Francais du Caoutchouc; "Mastication Polymerization," F. Watson, Rubber Producers' Research Association; "The Rubber-Like State," G. Gee, University of Manchester; "Radiation and Polymers," A. Charlesby, Royal Military College of Science; "Radiation Processing," T. Bain and W. H. T. Davison, Tube Investments Research Laboratories; "Urethane Foam Process," J. T. Watts, Imperial Chemical Industries; "Expanded PVC," F. Chapman, Whiffen & Sons, Ltd.; and "Properties of Cellular Polymers," A. Cooper, Expanded Rubber Co., Ltd.

ISO Seventh Annual Meeting

Delegates from 15 participating nations and observer groups from the International Electrotechnical Commission, International Union of Pure and Applied Chemistry, and the International Congress on Plastics Materials gathered at Buergenstock, Switzerland last July to take part in the seventh annual meeting of International Standardization Organization's Technical Committee 61. Program officers included chairman, Dr. G. M. Kline, National Bureau of Standards, Washington D. C.; co-chairman, Dr. W. Fisch, Ciba Co., Switzerland; and secretaries, H. Maurer, Secretariat SNV, Switzerland, and N. A. Skow, Synthane Corp., Oaks, Pa.

Alfred C. Webber, E. I. du Pont de Nemours & Co., reported on the action taken by ATCO (Atmospheric Temperature Coordinating Organization) at its first meeting in Paris during May 1957. In what was considered the most significant highlight of the year, it was revealed that ATCO will follow the recommendations of TC-61, made at The Hague in 1956, to advise each technical committee to adopt the fewest possible test and/or conditioning atmospheres from the following combinations:

Temperature	Relative Humidity
20° C.	65%
27° C.	65%
23° C.	50% (Astm D 618)

Among the test methods approved for circulation as first draft ISO proposals were: Izod and Charpy impact resistance; incandescence resistance of thermosets; thermal stability of PVC by the Congo Red and discoloration methods; and bleeding of colorants from plastics. A polyethylene melt flow method will be circulated as a third draft proposal, in addition to a recommendation that one method for standard atmospheres replace the two previously circulated.

Other U. S. delegates to the meting included: C. Howard Adams, Monsanto Chemical Co.; Robert Burns, National Academy of Sciences; Paul E. Willard, Food Machinery & Chemical Corp.; E. Y. Wolford, Koppers Co., Inc.; and Ralph K. Witt, Johns Hopkins University.

The 1958 sessions of TC-61 will be held November 3-8 in Washington, D. C. Delegates also are invited to participate in a symposium on plastics testing and standardization which will precede the TC-61 meeting, and will be held October 30-31 in Philadelphia, Pa.

ASTM Regional Conference

A new "Four Corners District of ASTM" has been planned for the four states of New Mexico, Arizona, Utah, and Colorado. An all-day technical session is scheduled for January 27, and all interested engineers and materials personnel are invited to attend. Some of the papers to be presented are outlined as follows: "Accelerated Aging Tests and Life-aging Properties of Aircraft Metal Adhesives," J. P. Thomas, Convair; "Testing and Exposure Life Test on Metallic Coatings," C. H. Sample, International Nickel Co.; "Testing for Mold and Fungus Resistance of Materials in Storage," C. J. Wessel, National Academy of Science; "Concrete and Its Life Qualities," W. K. Wagner, Albuquerque Gravel Co.; "Testing and Exposure Life Tests on Paints," Ralph Wirshing, General Motors Research Labs.; and "Materials for the Year 2000," R. T. Kropf, president of ASTM.

SPI Pacific Coast Section

The 1958 annual conference of SPI's Pacific Coast section will be held March 26-28 at the El Mirador Hotel, Palm Springs, Calif. The conference theme will be "Progress in Plastics," and featured speakers will include representatives from the aircraft, missile, and electronics fields, as well as the plastics processing industry. John L. Stief, Jr., Coast Mfg. & Supply Co., Livermore, Calif., will act as conference chairman, and Kay Stewart, Zenith Plastics Co., Gardena, Calif., will handle reservations and registrations.

Sponsors Elastomers Course

A fifteen-lecture course on Advanced Elastomer Technology is being sponsored by the New York Rubber Group beginning February 18. Lectures will be held at the Engineering Societies Building, 29 West 39th St., New York City, and the hours will be 7:30-9:45 p.m. Due to limited facilities, registration is limited to the first 200 applications received. Forms can be obtained by contacting L. C. Komar, Titanium Pigment Corp., 99 Hudson St., New York 13, N. Y. Fees are $25 for members, $28 for non-members.

The full program is listed as follows: February 18, "Characteristics of Rubber-Like Materials," William Slichter, Bell Labs.; February 25, "Molecular Structure," H. Mark, Polytechnic Institute of Brooklyn; March 3, "Characterization of High Polymers," A. M. Bueche, General Electric Co.; March 17, "Synthesis of High Polymers," John A. Davison, U. S. Rubber Co.; March 24, "Mechanical Behavior of High Polymers," Turner Alfrey, Jr.; March 31, "Reinforcement," Walter R. Smith, Godfrey L. Cabot; April 7, "Vulcanization," David Graig, B. F. Goodrich Co.; April 14, "Fluorocarbon Polymers," A. F. Abere, Minnesota Mining & Mfg. Co.; April 28, May 5, 19, 26, and June 2, "Compounding, Fabrication Techniques, and New Developments in Tires, Mechanical Goods, Wire & Cable, Floor Coverings, Footwear, Sponge & Foam Products, Cements & Adhesives, and Sundries"; and June 9, "Physics of Color," L. Wurtzburg, Interchemical Corp.

In these five Standard Units are all the necessary components to control effectively the degradation mechanisms that take place in polyvinyl chloride resins on aging, during heat processing or on exposure to sunlight. They are widely used alone and in combinations for specific effects in clear and opaque stocks. Their advantages have been proven over other tested materials, such as those based on tin (which frequently decolorizes effects of degradation without correcting them) or on lead (which frequently contributes to oxidation and breakdown on aging). To correct special conditions encountered in each Vinyl Processing Industry, we also supply combinations of selected components in these five Standard Units.

Write for information about stabilizers designed for versatile and inexpensive use in formulations employed in your particular vinyl processing industry.

Is it for—

Quality Vinyl Flooring?
Non-Plating Calendered Stocks?
Maximum Clear Sheets?
Non-Sulfur Staining Films?
Low Cost Clear & Opaque Hose?
Top Physical Properties in Rigids?
Air-Releasing Plastisols?
Controlled Slush Molding?

This Stabilizer System is for

Vinyl Flooring

Ba-Cd 12-V-1

Ba-Zn 19-V-2

The HARSHAW CHEMICAL Co.

1945 E. 97th STREET • CLEVELAND 6, OHIO

News of the Industry

American-English Venture

A prominent American manufacture of protective clothing, work gloves, and foul weather gear—Jomac, Inc., Philadelphia, has joined forces with a well-known English firm engaged in the same field—James North & Sons., Ltd. The net result is the formation of two new firms: Jomac-North, Inc., and North-Jomac, Ltd., which will manufacture certain products of the parent companies.

In this country, Jomac-North will produce PVC-coated garments, aprons, and gloves developed by the English firm. This clothing line seems to offer many added advantages over conventional protective apparel. Extremely light weight, they feature electronically-welded PVC buttons, welded seams sewn with chemically-resistant synthetic thread, and extreme flexibility. The clothing not only resists abrasion, but is difficult to puncture, and will not crack or become tacky.

In England, North-Jomac will manufacture work gloves of Jomac cloth, a special terry cloth developed or industrial use. The Jomac group has wide distribution throughout the United States, and North reputedly has the widest geographic coverage of any organization in the protective clothing field.

Forms Pearl Essence Company

A new supplier has entered the pearl essence field: Ultra Ray Pearl Essence Corp., Hyannis, Mass. Ernest J. Petow, whose father first introduced natural pearl essence in this country in 1915, will direct the operation. The firm already has introduced KO Pearl, a low-cost synthetic material which is said to equal the natural product in brilliance and covering qualities.

KO Pearl is manufactured as transparent, hexagonal-shaped crystals which are microscopic in size. It is available for dipping, spraying, calendering, and other blending operations. Unaffected by most solvents, the essence is stable to sunlight and ultraviolet.

Acquires Subsidiary Company

Acquisition as a wholly owned subsidiary of Reinhold Engineering & Plastics Co., Inc., Norwalk, Calif., has been announced by Haveg Industries, Inc., Wilmington, Del. The transaction was completed with the transfer of an undisclosed sum of cash, 4,845 shares of Haveg common stock, and options for Reinhold directors to subscribe to 950 additional shares of Haveg.

The acquisition will enable Haveg to extend its services on the West coast and to broaden its product lines with the addition of advanced equipment and know-how for the pressure molding of thermosetting plastics, as well as facilities for close tolerance hand lay-up and laminating work. Reinhold, employing 220 persons, produces and fabricates plastics for the aircraft missile industry as well as chemical corrosion equipment. No major changes in personnel are contemplated.

Schedules 14th U. S. Plant

Construction of a large methanol terminal at Hampton, S. C., together with facilities to produce 30-million pounds of formaldehyde annually, has been undertaken by Reichhold Chemicals, Inc., White Plains, N. Y. The company's 14th plant to be erected in continental United States, the Hampton facility is scheduled to go on stream July 1, 1958.

Enters Casting Field

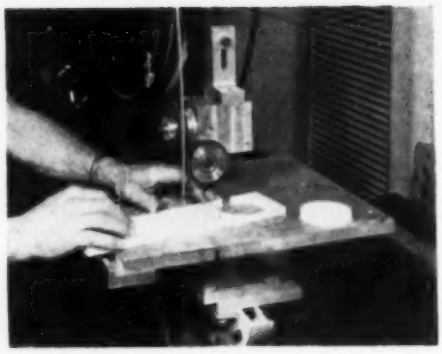
Specializing in the custom casting of polyesters and epoxies, a new company called Plasti-Skill, has been formed with fabrication facilities at Corona, N. Y. The firm produces jigs, fixtures, and decorative castings for the display trade, as well as models and production molds for vacuum formers.

Expands Vinyl Resin Output

Production facilities for Type VYHH vinyl resins are under construction at Union Carbide Chemicals Co.'s plant at Texas City, Tex. Addition of the new equipment, which is scheduled for operation during the spring of 1958, is expected to increase the company's output capacity by about 30%. Sales and service will be provided by Bakelite Co., New York, N.Y.

Designs Band Saw Adaptor

A set of roller attachments which will adapt the company's coated diamond band saw blade to all makes of band saw machines, is available from Dia-Chrome Co., Glendale, Calif. The device consists of a table which, when mounted on present supports, raises the working surface to afford space for one three-inch diameter rubber-tired wheel underneath. Two similar wheels are positioned above the table, providing a maximum working clearance of four inches.



Dia-Chrome attachment with 18-inch Oliver band saw.

This attachment is designed for contour sawing of glass reinforced plastic sheet stock, and permits cutting in any direction. By using a template and a pin positioned on the table, multiple thicknesses of 1/16 inch and 1/4-inch sheets can be sawed similar to a pin routing operation.

Issues Commercial Standard

Commercial Standard CS214-57, for reinforced plastics corrugated structural panels has been issued by the U. S. Department of Commerce. The standard, which became effective October 16, 1957, was developed by SPI's fiberglass reinforced panel council and the plastics section of the National Bureau of Standards. It is the tenth voluntary commercial standard developed through the joint efforts of these organizations.

Firm Elects President

Clowes M. Christie, president of American Latex Products Corp., Hawthorne, Calif., has been elected president of Dayton Rubber Co., Dayton, O., according to a recent announcement by the latter firm's board of directors. He succeeds A. L. Freedlander, who has occupied the presidency since 1936, and who now has been elected chairman of the board to direct company expansion, development of new products, and acquisition of subsidiary organizations.

Completes Research Facility

A one-story office and laboratory building, for use by its chemical division's PVC department at Leominster, Mass., has been completed by Borden Co., New York, N. Y. The facility will be operated in conjunction with the PVC resin plant opened at the same location last year. It is divided into three sections as follows: fundamental polymer research and development; semi-pilot operations; and technical service work on finished product processing and evaluation.

Plastics at Hotel Exposition

Though not exactly a feature, plastics did play a major roll at the National Hotel Exposition, which was held at the New York City Coliseum on November 11. Over 55,000 owners and operators of hotels and mass feeding businesses attended the show, coming from every state in the Union, Canada, Cuba, South America, and Europe.

Another item in this month's News of the Industry describes hotel owners' acceptance of Velvetex vinyl wall coverings. Columbus Coated Fabrics Corp.'s Guard vinyl wall covering and vinyl-coated Wall-Tex also attracted considerable attention. A complete line of furniture featuring high-pressure melamine tops, fronts, and sides demonstrated the versatility of this plastic. Available from Baumritter Corp., it was shown to withstand alcohol, water, ink, nail polish, and cigarette burns.

An interesting exhibit was displayed by Tropicraft of San Francisco. It included a series of reinforced plastic structural panels and room dividers, with imbedments of "woven wood" in 34 different patterns. Other plastics at the show were nylon conveyor belts for dishes, patterned melamine dinnerware, reinforced plastic trays, and vinyl plants and flowers.

Schedules Research Laboratory

Research, product, and process development activities will be stepped-up by Owens-Corning Fiberglas Corp., it was announced recently. A major move calls for the establishment of a Pioneer Laboratory, which will report directly to Games Slayter, vice president in charge of research and development. The lab will be located west of Granville, O., near Denison University.

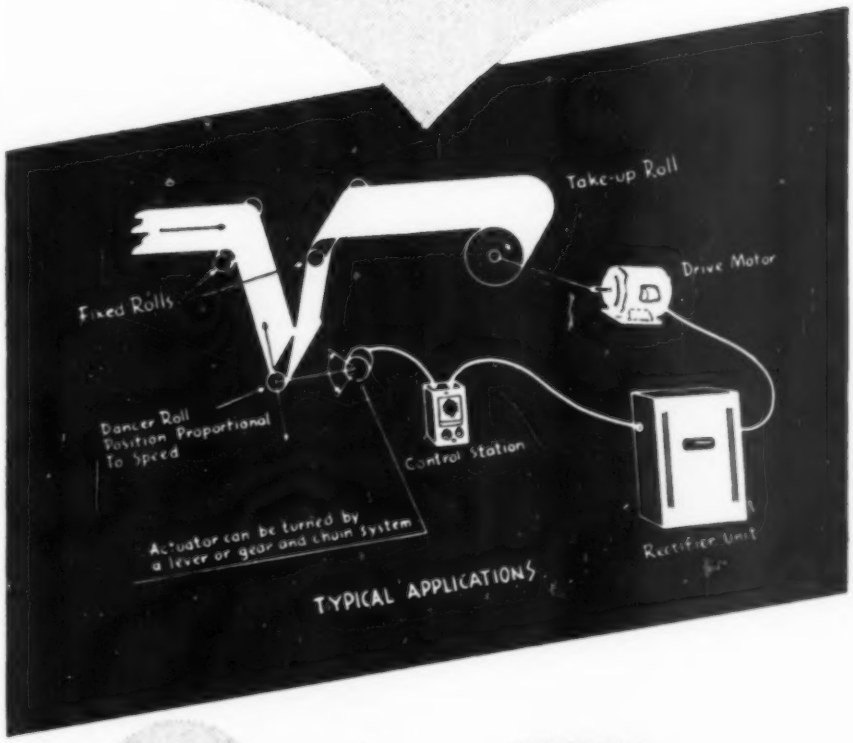
The new laboratory, operating independently of the firm's other research facilities, will be restricted to long-range development projects in fields related to Fiberglas. Construction is already underway.

Predicts Industrial Trends

"Continued growth for American business during the next ten years" was predicted by Joseph A. Hoban, vice president of marketing for the B. F. Goodrich Co. "We should never make the mistake of thinking that progress is automatic, but present growth trends indicate that our country's productive ability will grow from this year's $435-billion to more than $600-billion annually by 1967," he told the Marion, O., Chamber of Commerce at their 43rd annual meeting.

"Upturns in consumer spending in mid-1958 will come as the result of a sizeable step-up in personal savings during the past year," Mr. Hoban predicted, "and consumer break-through will be so substantial that the growth trend in general business will be continued." Reflecting optimism within his own industries (plastic and rub-

Servospeed
Automatic
Take-Up



Here's HOW IT WORKS ...for Textile and Plastics Processing

A small tension change positions the actuator shaft so as to call for motor speed change to restore preset tension. Thus a constant linear feet per minute windup may be achieved even though the radius of takeup roll increases with each turn to otherwise increase linear speed versus radius build-up. Speed is now made proportional to position of dancer roll and tension is held essentially constant, as is the linear rate of material travel.

These and other models of electronic motor speed control systems available from 1/50th to 2 horsepower.

WRITE

Servospeed
DIV. of ELECTRO DEVICES, Inc.
4 Godwin Ave. Paterson, N. J.

ber), he prophecied a 6% increase over 1957.

"The employment outlook should be bright," he continued, "since the number of persons between the ages of 18 and 65 will continue to increase at a slower rate than those under 18 and over 65 years. The demand for workers should be so great that all those willing to work will have little difficulty in finding jobs." Mr. Hoban also felt that Ohio will rank as the number one manufacturing state in the nation by 1967.

Adds Production Facilities

An additional 10,000 square feet of storage space has been acquired by Alpha Chemical & Plastics Corp., Newark, N. J., thus freeing a proportionate part of its 25,000 square-foot plant for the installation of production facilities. A modern dry-blending installation is in operation, along with many other new equipment items. An affiliate of Rotex Rubber Co., Alpha expects to increase its 2-million pound production of reprocessed vinyl and polyethylene.

Among the personnel added to the research staff are Theobaldo Tames, chief chemist in charge of quality control, and Pascal LaGrutta, who will serve as manager of production and engineering. Alpha now offers a number of compounds for molding and extrusion.

Fire Retardant Roofing

A fire-retardant material, consisting of a flame-resistant Koroseal vapor barrier film and non-flammable Lexsuco adhesive, is being used to cover 34 acres of roofing at Chrysler Corp.'s newly-constructed stamping plant at Twinsburg, O. The materials are manufactured by B. F. Goodrich Industrial Products Co., Akron, O., and are engineered and distributed by Lexsuco, Inc., Cleveland, O.

The construction eliminates asphalt materials from between the roof-deck and insulation which, during fire, form combustible gases that feed the flames. This roofing system has been approved by Factory Insurance Association, and has been awarded a Class I rating by Factory Mutual Laboratories, Norwood, Mass.

Builds Textile Fiber Plant

A textile fiber plant, designed to produce commercial quantities of Zefran at Lee Hall, Va., is being constructed by Dow Chemical Co., Midland, Mich. Scheduled for completion in early 1958, the plant will include production, research, development, administration, and sales facilities.

Zefran, a recently developed textile fiber, has been described as a nitrile alloy, specifically designed to fit into conventional textile manufacturing and dyeing operations. The material exhibits flexibility in the choice of dyestuffs; resists deformation at high temperatures; has less tendency to pill and glaze; and processes well both alone, and in blends with wool, cotton, or rayon.

Acquires Voting Stock

Fifty per cent of the voting and issued stock of Plax Corp., Bloomfield, Conn., has been acquired by Monsanto Chemical Co., St. Louis, Mo. The 250,000 shares were purchased from the Owens-Illinois Glass Co., in exchange for 325,000 shares of Monsanto common stock. Remaining interest in the Plax Corp., will continue to be held by Emhart Mfg. Co., Hartford, Conn.

Expands Production Facilities

Construction of plant and office facilities, costing $260,000 and covering 31,000 square feet, has been undertaken by Flambeau Plastics Corp., Baraboo, Wis. The company, which manufactures a line of housewares, premium items, and advertising specialties under the brand name Flambo-Ware, expects to occupy the new premises by May 1, 1958.

In Brief . . .

Commercial Plastics & Supply Corp., has been appointed distributor for two plastic sheet products: Campco styrene and Wasco Products' Acrylite sheet.

Marbon Chemical, division of Borg-Warner Corp., has announced the availability of externally-lubricated Cycolac pellets for injection molding.

Monsanto Chemical Co., has modernized its block "M" trademark to produce a more readable company symbol. A hand-lettered, Gothic type face was substituted for the Roman face previously used.

Archer-Daniels-Midland Co., has announced that its Admex 77 primary epoxy plasticizer has been approved by the Food & Drug Administration for use in vinyl films and tubing which are used for wrapping and handling foods.

E. I. du Pont de Nemours & Co., Inc., has changed the name of its chemical department to the central research department. No change in activities or research function is involved.

Allied Chemical & Dye Corp.'s Barrett division has announced the availability of a virtually moisture-free Plaskon molding compound, supplied in hermetically-sealed 25-pound cans.

Dow Chemical Co., has announced a price reduction of approximately 1½ cents per pound in the delivered price of styrene-butadiene latices in tank car lots. General-purpose grades of crystal polystyrene were reduced 1½ cents per pound in bags, and colored polystyrene in bags was reduced ½ cent per pound.

Automatic Molding Machine Co., has named C. H. Whitlock Associates as its representative for Automold compression presses in eastern Michigan, Indiana, and Ohio.

Formica Corp., division of American Cyanamid Co., has announced the addition of Colorgrains to its line of Sunrise laminates. Four colors: blue, yellow, coral, and gray are available in soft, woodgrain tones.

American Viscose Corp.'s film division has opened the largest cellophane distribution center, independent of a manufacturing plant, in Melrose Park, Ill. The move from downtown Chicago is expected to afford better service for customers in the central, southwestern, and Rocky Mountain states.

Visking Co., has announced the appointment of Cadillac Plastic & Chemical Co., as distributors of Visqueen polyethylene film. The firm maintains warehouses in Detroit, Chicago, Cleveland, Dallas, Los Angeles, Milwaukee, San Francisco, and St. Louis.

Goodyear Tire & Rubber Co.'s chemical division has opened a new field office at 6500 Mt. Elliott Ave., Detroit, Mich. L. P. Thies will direct the operation.

Seiberling Rubber Co., has appointed the Chester A. Olsen Co., as distributor of its formable sheeting in Illinois, Indiana, Wisconsin, and the city of Minneapolis.

Shaw Process Development Corp., has licensed Precision Plastics, Philadelphia, Pa.; Star Foundry, Fort Wayne, Ind.; and General Mold Casting, Newark, N. J., to produce cavities and cores by the Shaw process of precision investment casting.

Names in the News

Gordon P. Hungerford

Gordon P. Hungerford has been elected vice president of Kordite Co., division of Textron, Inc. He joined the firm last year as general manager of research and engineering, having previously served as research manager for American Machine & Foundry Co.

Alfred P. Marone has been appointed Los Angeles district manager of Witco Chemical Co. He will not only serve as sales manager for the area, but will be responsible for the operation of the LA plant.

Harry A. Riley, Jr., has been appointed sales manager, wholesale division, for Southwestern Plastic Pipe Co., Mineral Wells, Tex. He has been directing sales development work for the firm.

H. I. Allen has been named to head up the technical service group of Oronite Chemical Co.'s marketing department. He succeeds **M. P. Youker,** who was recently promoted to assistant manager, western exports. **Thomas J. Shea** has been added to the sales staff in the New York region.

Thomas Harrison Davies

Thomas Harrison Davies has taken over as director of research for the Mellon Institute. Dr. Davies, who had been administrative head of the Multiple Fellowship sustained in the Institute since 1952 by Pittsburgh Plate Glass Co., has had a distinguished career in scientific research and management.

David Brandmark has been named technical representative for Claremont Pigment Dispersion Corp., in both New York and New Jersey.

John Achelis has been elected vice president in charge of sales for the newly-formed Inso Products, Ltd., a wholly-owned subsidiary of Adam Consolidated Industries, Inc. He will supervise market development of Inso's new process for applying thin Teflon films to copper wire.

Robert R. Moyer, manager of technical service, styrene molding materials, for Monsanto's plastics division, has been named assistant director of technical service. He replaces **Ivan V. Wilson,** who has been named patent consultant for the division's research department. **Bennett Nathanson** succeeds Mr. Moyer.

Elmer J. Collins

Elmer J. Collins, retired U. S. Army Colonel, has been named product development engineer for Borg-Warner Corp.'s Marbon Chemical division. Former commanding officer for the Army Chemical Procurement Center, Mr. Collins has extensive experience in engineering, product development, instrumentation, and production.

Robert A. Mitchell has been appointed chief engineer for the midwest headquarters of Blaw-Knox Co.'s chemical plants division. He joined the firm in 1951 after a tenure with American Cyanamid Co.

Phillips Chemical Co. has added the following men to its plastics sales staff: **A. R. Beckett,** Pasadena, Calif.; **C. J. Silas,** Bartlesville, Okla.; **R. V. Porter** and **C. H. Luling III,** Elmhurst, Ill.; **L. A. Grundy,** East Providence, R. I.; **C. R. Loden, R. F. Lynch,** and **F. M. Jackson,** New York City; **A. C. Levinson,** Akron, O.; and **F. C. Blue,** Bartlesville.

STATIC??

For smoother product flow unhampered by troublesome static, investigate the IONOTRON. This compact device, specially adapted to your own production equipment, ionizes the air in the immediate vicinity of the static charge, thereby causing neutralization of the static. The IONOTRON requires no electrical connections and, because of its unique construction, can be readily installed on equipment at the point of greatest disturbance. U. S. Radium engineers will consult with you on specific installation and application problems.

THE STATOMETER . . . . . . an instrument for detection and measurement of static disturbances. If static is your problem, the STATOMETER can readily provide information as to its source, intensity and polarity. Write for Bulletin 20.61.

UNITED STATES RADIUM CORPORATION

MORRISTOWN, N.J.

Offices: Chicago, Illinois and No. Hollywood, Calif. Affiliates: Radelin-Kirk, Ltd., Toronto, Canada and United States Radium Corp. (Europe), Geneva, Switzerland

USRADIUM

News from Abroad

British Plastics Statistics

Figures just released by the British Board of Trade show a marked upturn for plastic sales during the first half of 1957. Actual increase over a corresponding period last year was 36,100 tons, or approximately 19%. Exports accounted for 27% of total sales (52,500 tons), for a net increase of 8,000 tons.

Three materials accounted for most of the gains: polyethylene, polystyrene, and PVC. Thermosetting material sales went up about 5%. The table below gives totals and breakdown for plastic sales during the first and second halves of 1956, as well as for the first half of 1957.

	Jan.-Je. 1956 tons	July-Dec. 1956 tons	Jan.-Je. 1957 tons
Thermosetting materials:			
Alkyds	20,100	19,400	22,500
Aminoplastics	24,800	24,200	25,700
Casein plastics	1,400	1,300	900
Phenolics and cresylics	33,100	31,500	33,300
Polyesters	1,000	1,200	1,400
Others	1,700	1,700	2,400
Totals	82,100	79,300	86,200
Thermoplastic materials:			
Cellulosics	5,600	5,800	6,100
PVC	23,000	24,100	32,000
Polystyrene	10,700	13,100	14,600
Vinyl acetates	6,000	5,000	6,900
Polyethylenes, acrylics, and nylon	37,500	45,400	50,200
Totals	82,800	93,400	109,900

Terylene-PVC Mine Belting

A new type of Terylene-PVC mine belting, approved by Britain's National Coal Board, is composed of three plies of Terylene-reinforced fabric coated with PVC.

Developed by Rubber Improvements, Ltd., Wellingborough, England, the new belt, although only half as thick as a six-ply cotton belt, is just as strong, but is lighter and more flexible, in addition to being flame-proof. The low stretch and low moisture absorption of terylene prevents variations in length from changes in humidity. The strength of the fiber absorbs shock more readily, thus reducing damage, while its flexibility prevents straining and cracking of the PVC as the belt passes over the pulleys. It is expected that the new belts will be used extensively in the coal mining industry.

Damage Plastic Insulation

Rats will damage practically any kind of insulation but steel strip, a Swedish investigation has revealed. Fires, traced to rat attack on cable insulations, led Sieverts Kabelverk A/B Sundbyberg, to undertake fairly large-scale experiments to determine what materials would be safe. The Veterinary College of Stockholm collaborated on the project.

Wires insulated with various PVC materials, polyethylene, nylon, natural rubber, butyl rubber, neoprene, silicone rubber; as well as cable sheathed with lead, aluminum, glass fiber, braided copper wire, and steel strip were exposed to tame, well fed white rats. As mentioned earlier, only the steel strip offered 100% resistance.

In the case of rubber-insulated wire, covered with lead and PVC, only the copper remained intact. A field cable insulated with polyethylene and nylon was damaged seriously. Cables covered with rigid PVC did afford some protection, as did rat repellents. One conclusion was that rats, however well fed, have an instinctive curiosity which must be guarded against at all times.

Vinyl-Coated Steel Sheet

What is purported to be the first continuous-strip mill, cold-reduced laminate of vinyl and steel has been introduced by John Summers & Sons, Ltd., in cooperation with BX Plastics, Ltd. Called Stelvetite, the material consists of a special PVC coating 14 mils thick, bonded to a pre-treated steel by means of a vinyl chloride-synthetic rubber adhesive.

Stelvetite laminates are claimed to be superior to those manufactured in the United States. They are available in steel gages ranging from 0.0196-0.625 inch, and in four standard colors. The surface is lightly embossed; however, other finishes and colors can be supplied with quantity orders. The material can be bent, cut, and perforated. Suggested applications include wall panelings, office furniture, fittings, containers, cabinets, and kitchen equipment.

Tropical Resistance of Nylon

The British Ministry of Supply recently has made available a report by the Tropical Testing Establishment in Nigeria, which covers the tropical resistance of nylon monofilaments. Results show that all specimens and coils tested were discolored at hot, damp sites. This was caused by vegetable debris and algae involvement. Algal growth did not appear to damage the material, however.

Under hot, dry conditions, nylon 66 samples bleached. Nylon 610 became yellow and opaque, with subsequent surface crazing and flaking. Termites can break fine strands of nylon, but there is no evidence that they eat the material. Under humid conditions, nylon 66 monofilaments increased in length. There was a slight loss in tensile strength and elongation over a period of 24 months, which was found to be less marked in the case of nylon 610. Under hot, dry conditions, the filament shrank nearly 2%. Tensile strength fell to nearly ¼ its original value, and elongation was cut in half.

Dow Opens Hong Kong Office

A sales office has been opened in Hong Kong by Dow Chemical International, Ltd., an export subsidiary of Dow Chemical Co. Eric C. Huggins, former Far Eastern plastics sales manager in Tokyo, will be in charge of the operation. The new office should make Dow products more readily available throughout Southeast Asia, and will provide a closer working relationship with customers and sales representatives in the area. In addition to the two above-mentioned sales offices, Dow maintains a resident sales supervisor in Sydney, Australia.

Agree on Cross Licensing

Catalin Corp. of America and Societe Francaise D'Organo-Synthese, the latter firm being one of several chemical companies comprising the Roger Bellon Enterprises of Neuilly-Paris, France, have completed a cross licensing agreement. This marks the third step taken by Catalin as part of an over-all move towards international distribution and diversification of its chemical division products.

The agreement calls for an exchange of know-how, technical information, and formulas for chemical intermediates. Organo-Synthese is an important French producer of chemicals for the plastic, rubber, pharmaceutical, textile, petroleum, and cosmetic industries. Last June, Catalin signed a five-year contract with Adhesivos Resistol, S.A., of Mexico, for an exchange of technical information. In October, it completed a similar agreement with Cie Centrale Rousselot, Paris, France, for an exchange of information on the manufacture of solid one-stage and two-stage phenolic resins.

U. S. Polymeric Expands Abroad

One of Britain's foremost manufacturers of plastic products has entered into an agreement with U. S. Polymeric Chemicals, Inc., Stamford, Conn., whereby they will duplicate the American firm's line of impregnated fabrics, papers, and mats. The English company is Aeroplastics, Ltd., a subsidiary of Fairey Aviation Co., Ltd. Considerable interest has been generated overseas by U. S. Polymeric's prepreg line, and Aero personnel have been studying production facilities and engineering techniques employed at Stamford.

In still another move, U. S. Polymeric plans full-scale production in the Netherlands. A new impregnating plant in Utrecht is nearing completion, and should begin actual production in March of this year. This factory will turn out melamine, polyester, silicone, phenolic, and epoxy prepregs. During construction, temporary offices are being maintained at Jaarbuersgebouw Vredenburg, Utrecht.

In Brief . . .

Rodney Hunt Machine Co., Orange, Mass., has appointed W. J. Westaway Co., Ltd., as sales representative for its industrial roll division in Canada. Westaway maintains offices in Montreal, P. Q., and in Hamilton, Ont.

Marbon Chemical, division of Borg-Warner Corp., has announced price cuts of 5¢ per pound for powdered Cycolac resin, and 7¢ per pound for the pellets.

E. I. du Pont de Nemours & Co., has moved the opening date of its 50-million pound-per-year cellophane plant near Tecumseh, Kans., from 1959 to late 1958.

Epoxylite Corp., has appointed C. D. LaMoree Co., as distributor of its Epoxylite formulations in Arizona and California.

Glastic Corp., a manufacturer of glass-reinforced polyester Class B electrical insulation, has established a northeastern regional sales office in Scotia, N. Y.

National Distillers Products Corp., has announced a change in corporate name to National Distillers & Chemical Corp. Chemical business will continue to be conducted under the divisional name, U. S. Industrial Chemicals Co.

Cellofilm Industries, Inc., has appointed Phillips & Martin Co., Chicago, Ill., as exclusive sales agent for its nitrocellulose base solutions.

General Tire & Rubber Co.'s Textileather division has announced the availability of Tol-x Glovette, the softest vinyl fabric ever produced commercially. The material features a vinyl coating over a napped back-fabric.

B. F. Goodrich Industrial Products Co., has announced plans for the construction of a $2½-million adhesives plant in Akron, O.

F. J. Stokes Corp., has opened a sales office in Atlanta, Ga. William J. Fisher will direct the operation.

Permalite Plastics Co., now operates as Permalite Plastics Corp., at a new location. The address is 608 Terminal Way, Costa Mesa, Calif.

Tumb-L-Matic, Inc., has moved its plant and offices to St. Marys St., Stamford, Conn.

General Tire & Rubber Co.'s Bolta Products division has announced the availability of a blond woodgrain pattern in Bolta-Top, its flexible plastic laminate for counter and table tops.

Formica Corp., a subsidiary of American Cyanamid Co., has formed an export department, with Edward B. Flagg serving as manager. The department will service South and Central American countries.

Easton Plastic Products Co., Inc., has announced a change in corporate name to Mannesmann-Easton Plastic Products Co., Inc.

Highly Intimate Blends in 1 to 2 Minutes

Blends while discharging; No segregation or flotation

Sturtevant Rotary Blenders start 4-way blending while charging, continue it during discharge, thus producing highly intimate, even blends of dry and semi-dry materials – within 3 to 5 minutes of start of charging.

Six *complete* blending cycles per hour are common. And Sturtevant's special action produces no particle reduction, cleavage or attritional heat – is highly effective yet gentle and safe even with explosives.

Receiving

Scoops cascade material as drum rotates. Movement forces material from both ends to middle. Thus blending is 4-way right from start of charging.

Discharging

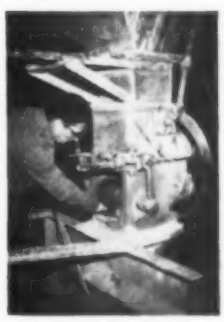
Single gate controls charge, discharge. Blending continues throughout discharge phase. Result is no segregation or flotation — highly intimate, even blends.

Self-cleaning, dust-sealed drum; one-man accessibility

Operation of Sturtevant Blenders is self-cleaning – drum interiors are completely dust-sealed. For inspection of all models, one man simply loosens a few lugs to remove manhole cover – quickly and easily.

Nine standard models with capacities to 900 cu. ft.

10 cu. ft. Sturtevant Stainless Steel Blender at U.S. Steel's Applied Research Laboratories. Corrosion and contamination-proof, this unit handles batches up to 500 lbs. — is ideal for critical work or small runs.



25 cu. ft. Sturtevant at Bird & Son, Inc., Roofing Materials Div., used to blend rock granules and pigment. Injector system supplies solution to bind color to granules. Cleanout of sticky granules is done by injecting water and raw granules at end of each shift or when color is changed, scouring drum interior.

Fully or semi-automatic, or manually controlled operation

Constructed of carbon steel, stainless steel or Monel metal, Sturtevant Rotary Blenders are engineered to fit each customer's needs – can be supplied with injector sprays and any desired control system.

For more on Sturtevant Blenders, request Bulletin No. 080B. (Bulletins also available on Mixers, Air Separators, Micronizers, Crushers and Grinders.) Write today. STURTEVANT MILL CO., 155 Clayton St., Boston, Mass.

New Materials

Write item numbers on Readers' Service Card to obtain more information.

Isotactic Polypropylene Resin

Over a year ago, we first described the development by Guilio Natta of a catalytic process for polymerizing olefins and diolefins to obtain high-yield "isotactic" polymers. Under the sponsorship of Montecatini (Societa Generale per L'Industria Mineraria e Chemica), Milan, Italy, this process was adapted to the stereospecific polymerization of propylene, an asymmetric olefin available from both the petroleum and petrochemical industries. The result is polypropylene, a thermoplastic resin now being introduced commercially by Montecatini under the tradename Moplen.

Montecatini's annual production is reported at 15-million pounds, and the firm claims to be capable of quadrupling this figure at any time. Its unusual thermal properties, coupled with other excellent characteristics, make it a very interesting material with possible applications in the following fields: heat-sterilizable equipment, piping, fittings and valves, packaging films, insulation, vacuum formed parts, and many others. Spun into fibers and filaments, it promises many textile and industrial uses.

Two types of Moplen are being produced: M 1, which has a melt index of about 20, is highly fluid in the melted state and is therefore suited to film extrusion and blow molding; and M 2, which has a melt index of six and is recommended for injection molding and the extrusion of pipe and shapes.

In injection molding, it is recommended that cylinder temperatures be maintained at 392-500° F., and that the temperature at the nozzle should be about 54° F. less than that in the cylinder. The mold should be run at about 176° F., and pressures may range from 10,000-17,000 psi. Linear shrinkage is about 3%, and normal rules can be followed in establishing mold sizes. Warpage can be avoided by leaving the piece in the mold for a period sufficient to ensure complete solidification. Similar to polyethylenes, as might be expected, it can be protected against sunlight through the addition of dispersed carbon black.

Extrusion is carried out in much the same way as with polyethylenes—the screw has a 4:1 compression ratio and length equal to 18-20 times its diameter. Again, as with polyethylene, the normal methods of assuring uniform temperatures in the barrel must be employed. Temperatures generally employed for pipe extrusion are: barrel, 347° F.; nozzle, 392° F. In both injection molding and extrusion, care should be taken to clean the machine after a day's run. In vacuum forming, sheets should be blocked into the frame after they have already undergone partial thermal softening.

Typical physical properties of the Moplens, as determined by ASTM test methods, are reported as follows:

Specific gravity	0.90-0.91
Density	0.4
Bulk factor	2.25
Yield strength, psi.	4,300-5,000
Ultimate tensile strength, psi.	4,300-5,700
Elongation, ultimate, %	10-20
Compressive strength, psi.	8,500-10,000
Stiffness, flexural, psi.	114,000-170,000
Hardness, Rockwell R.	85-95
Impact strength, Izod, ½ x ½ in. unnotched bar ft. lb./in.	19
Young's modulus, dynes/cm² x 10^{10}	3.0-3.3
Water absorption, %	Nil
Dielectric constant, 10^6 cycles/sec.	2.0-2.1
Dissipation factor, 10^6 cycles/sec.	0.0002-0.0003
Dielectric strength, V/mil.	70-80
Volume resistivity, ohm-cm.	10^{16}
Thermal conductivity, Btu./in./ft²/hr./°F.	0.95
Specific heat K cal./gm./°C.	0.46
Coefficient of thermal expansion, in./in./°F.	61 x 10^{-6}
Brittleness temperature, °F.	<14
Softening point, °F.	>284
Vicat, 5 kg.	>185
Resistance to heat, no strain, °F.	302

Readers' Service Item M-1

Secondary Vinyl Plasticizer

Kenplast, a recent introduction of Kenrich Corp., has proven quite successful as a plasticizer in vinyl hose and wire coating formulations. A light-colored petroleum derivative, it can be used to replace up to 25% of the more expensive ester plasticizers. This percentage varies with the filler used, and higher compatibility limits have been reported.

The material's excellent color stability —100 hours under the Fadeometer— would indicate its usefulness as an extender for light colored stocks. It is also recommended for improving cold bend.

An average analysis reveals the following data:

Specific gravity	0.90
Viscosity at 100° F., Saybolt seconds	55
Flash point, Claveland open cup, °F.	280
Pour point, °F.	—55
Color, ASTM	1.5
Aniline point, °F.	160

Readers' Service Item M-2

Polyester Terminating Agent

Pilot plant quantities of 2,2-dimethyl-4 pentenal and its corresponding saturated alcohol, 2,2-dimethylpentanol are available from Eastman Chemical Products, Inc. Absence of hydrogen on the alpha carbon atom in the alcohol molecule suggests its use as a terminating agent for polyesters, or in other reactions where dehydration stability is required. Presence of the neopentyl configuration should make the alcohol suitable for applications requiring heat stability.

The primary, heptyl alcohol is capable of undergoing esterification and etherification. The unsaturated aldehyde is used as an intermediate in the production of the corresponding saturated alcohol. Typical properties of both compounds are reported as follows:

	alcohol	aldehyde
Density	0.825	0.8313
Refractive index	1.4256	1.4201
Boiling point, °C	150	126.8-129.6
Color, APHA	10	10
Flash point, Cleveland open cup, °F	135	80
Fire point, Cleveland open cup, °F	145	85

Readers' Service Item M-3

Cyanoacrylate Adhesive

An easily applied cyanoacrylate compound that will set quickly to form a strong bond between materials not normally respondent to conventional adhesives, has been developed by Eastman Chemical Products Co. Tradenamed Eastman 910 Adhesive, the material is a monomer modified with a thickening agent and a plasticizer.

No heat, excessive pressure, or catalysts are necessary. When the monomer is pressed into a thin film between two clean surfaces, a polymerization occurs which results in a relatively rapid set. The solidifying action takes place without appreciable change in volume, and does not depend upon the evaporation of a solvent. Tests have shown glass-to glass bonds to be unbreakable within five to 15 seconds, whereas steel-to-steel bonds set in 15-20 seconds and will develop tensile strengths of 2,000 psi. in 30 minutes, and 5,000 psi. after 48 hours. Some of the plastics with which the material can be used are cellulose acetate, cellulose acetate butyrate, styrene, polyester glass laminates, epoxies, acrylates, urethanes, and vinyls.

The bond possesses good solvent-resistance properties and immersion in alcohol, benzene, or acetone for periods as long as 24 hours will not affect it greatly. Exposure to steam, however, or prolonged exposures to combinations of high humidity and high temperature will cause its permanent breakdown. The ultimate limit of the bond's thermal stability is defined by the 160° C. softening point of the cured adhesive.

A summary of the physical properties of commercial grade Eastman 910 Adhesive, containing approximately 90% monomer and 10% thickening agent, plasticizer, and stabilizer, is as follows:

Appearance	Cloudy, colorless, liquid
Viscosity @ 25° C., cps.	100 (approx.)
Density, grams/cm.^{3}	1.11
Lbs./gal.	9.25
Flash and fire point, Cleveland open cup, °F.	180
Solubility in nitromethane	Soluble

Readers' Service Item M-4

Two Azo Pigments

Two pigments, Plasticone Red Light 10465 and Plasticone Red Medium 10464, have been added to the product-line of Sherwin-Williams Co. Based on substituted pyrazolone intermediates, these azo reds exhibit heat resistance, and while they do bleed slightly in toluene and lacquers, they are relatively insoluble in water, other organic solvents, and plasticizers. They have good light resistance in full shade; fair resistance in tints; are soft grinding and easily dispersed; are resistant to water and acid; and sufficiently resistant to alkali and soap to be used in soap wrapper and carton inks. Both materials have a specific gravity of 1.46; weight per solid gallon, 12.16 pounds; and bulking value, 0.08224 gal./lb. Red Light has an oil absorption value of 47, while that of Red Medium is 50. Reflectance values for the pigments are 8.3 and 7.5, respectively.

Especially recommended for use in vinyl plastics, polyethylene, polyesters, and rubber, the Plasticones will not crock when used with common plasticizers and do not migrate into adjacent white stocks. The light shade, 10465, can be used with the company's Light-fast Molybdate Orange Deep, 12165, to make intermediate shades of deep orange or yellowish red without loss of brilliance. Intermediate combinations of the light shade, 10465, and the deep shade, 10457, are recommended in preference to the medium shade, 10464, for convenience in stocking only two pigments. For deeper hues, combinations with the maroon, 10458, are suggested.

Readers' Service Item M-5

Non-Staining Antioxidant

A non-staining antioxidant, claimed to be at least four times more effective than other commercially available non-staining antioxidants, has been placed on the market by Monsanto Chemical Co. Recommended for use with both high- and low-pressure polyethylenes, the material, tradenamed Santonox, is a dialkyl phenol sulfide meeting the following specifications:

Appearance	Light gray or tan powder
Ash	0.05% (max.)
Fineness	Trace retained on 50-mesh sieve (wet)
Melting point	145° C. (min.)
Moisture	1.0% (max.)

VANSTAY®

Vinyl heat and light stabilizers

Our trade mark of 12 years standing came into being with VANSTAY L, the first nontoxic light stabilizer for Vinyls.

Today, the VANSTAY line includes a number of materials developed to keep pace with Industry's demands for higher temperature Vinyl protection in process and in service.

Expanded research and technical service can be of immediate assistance in solving your Vinyl stabilization problems.

R. T. Vanderbilt Co., Inc.

230 PARK AVENUE · NEW YORK 17, N. Y.

Protection against loss of color, loss of tensile strength and embrittlement are vital to your successful marketing of vinyl products. You know this!

But, perhaps you do not know the complete story of Metasap Vinyl Stabilizers — designed specifically to assure you relief from the effects of heat and light.

Whether you are producing film, sheeting, floor tile or plastisols there's a Metasap Stabilizer to do the job . . . better.

Send for free factual folder today.

METASAP CHEMICAL CO.
HARRISON, NEW JERSEY

Chicago, Ill. • Boston, Mass.
edartown, Ga. • Richmond, Calif.
London, Canada

A NOPCO Subsidiary

METASAP CHEMICAL CO.
Harrison, N. J.

Gentlemen: Kindly send me your booklet "Metasap Vinyl Stabilizers".

NAME_____

FIRM_____

ADDRESS_____

CITY_____ STATE_____

While it is listed as a light gray or tan product, it will not impart initial color to the polyethylene, because the recommended use levels are extremely low. The antioxidant also is available in a refined grade, Santonox-R, which combines similar low color, odor, and crystallinity qualities with a slightly superior efficiency.

Laboratory tests indicate that polyethylenes compounded with 0.05% Santonox, show excellent flow retention and recovery characteristics even after 45 minutes of hot milling. Electrical compounds using the same antioxidant concentration will meet MIL-D-3054A which requires that the dissipation factor, for high frequency use, shall not exceed 0.0005 at 50-100 megacycles after 2½-3 hours of milling at 160° C. Santonox also imparts good heat and outdoor weathering stability, and the compounded product will retain its impact strength and tensile properties.

A higher melting point and lower sublimation rate reduce its volatile loss during heat processing, thus increasing its permanence. The material is approved by the Food and Drug Administration for use in polyethylene films intended for food wrapping. Its maximum extractability, as used in practice, corresponds to less than 0.02 parts per million of food. Toxicity studies on Santonox show it to be only slightly toxic when ingested, and patch tests indicate that it is essentially non-irritating and not a skin sensitizer.

Readers' Service Item M-6

Saturating Base Paper

A saturating base paper for electronic laminates and other applications requiring a high absorbent capacity has been developed by Knowlton Brothers, Inc. Designated Grade #101, the paper has a high alpha-cellulose content and gives a water rise of $^{15}/_{16}$-1¼ inches per minute in a Klemm capillarity test.

Weight is controlled to within ±4% throughout, and the paper is available in thicknesses from about 0.003-0.018 inch, while roll widths range from 72-80 inches. Absorbent capacity, weight, and thickness, can be controlled to meet customer specifications.

Readers' Service Item M-7

Methallyl Acetate Monomer

The FMC organic chemicals division of Food Machinery & Chemical Corp. is now offering methallyl acetate (isobutenyl acetate), with a guaranteed minimum purity of 97%. This material is used primarily as a monomer in polymerization reactions, and shows promise in safety glass liners, molding powders, castings and laminates, adhesives, protective coatings, and specialty rubbers. Properties are reported as follows:

Molecular weight	114.14
Specific gravity	0.9162
Boiling point, °C.	124.5-125

Readers' Service Item M-8

Acrylic Molding Powder

A medium cost modified acrylic molding powder, called Implex, has been placed on the market by Rohm & Haas Co. The material reportedly contains no plasticizers, has low water absorption, excellent stain resistance and yields molded items having superior toughness and impact strength that can be readily machined, nailed, and cemented. A field evaluation has shown the material to be particularly suitable for such applications as shoe heels, piano keys, business machine keys, pen and pencil parts, knobs, valve parts, and numerous types of housings. A summary of the physical properties of Implex includes:

Property	Average Value	ASTM Method
Specific Gravity	1.12	
Tensile Strength, psi., max.	5,200	D 638-52T
Modulus of Elasticity, psi.	220,000	
Elongation at Break, %	30	
Flexural Strength, psi., max.	8,000	D 790-49T
Modulus of Elasticity, psi.	235,000	
Impact Strength, ft.-lbs.:		D 256-47T
Charpy unnotched @ 73° F.	30	
Izod notched @ 73° F.	2.0	
Heat distortion temperature, ° F.	194	D 648-45T
(2° C./min. @ 66 psi.)	194	
Water absorption,		
24 hrs. immersion @ 73° F., %	0.3	D 570-42

Readers' Service Item M-9

New Equipment

Write item numbers on Readers' Service Card to obtain more information.

Erdco's Clear-Pac Bubble Sealer.

Blister-Pack Sealing Unit

A high-speed, automatic machine designed to seal most small merchandise in a transparent, plastic bubble has been developed by Erdco Engineering Corp. Called the Clear-Pac Bubble Sealer, it is operated easily by the unskilled worker.

Card- and bubble-sizes up to six by nine inches can be handled at speeds of 5-15 packages per minute. Package size can be changed in three minutes. Power is 220 volts, 60 cycles, one phase. The unit is finished in two-tone baked enamel, and measures four by six feet. It stands approximately three feet high.

Readers' Service Item E-1

Laboratory Processing Mill

A laboratory mill, suitable for experimental and production runs up to 15 pounds, is available from Todd Shipyards Corp. The mill incorporates a basically simple design which may be modified to give many special or optional features.

The rolls are made of hollow forged steel finished with chrome plate. The journals rotate in bronze bearings supported by solid cast Meehanite blocks, whose inner faces are provided with oil seals. Bearing blocks are secured in the roll end frames by cap bars which may be removed easily for disassembly. Rotary seal piping connections permit the use of heating or cooling media, and perforated copper spray tubes provide efficient heat transfer through the rolls. Roll guards are made of ¾-inch laminated phenolic and are arranged for wear- and self-adjustment to suit horizontal movement of the front roll.

The constant-speed, squirrel-cage, gear head-drive motor, may be supplied with electrical characteristics to suit the available power source. It is operated by means of a start-stop-reverse switch, and an across-the-line magnetic starter. A cradle type safety switch, arranged for operation from either the front or back of the unit, is provided to bring the equipment to an emergency stop. Power is transmitted to the back roll through an enclosed, heavy duty, roller chain, provided with a take-up.

Alloy-steel gears are designed with a special tooth form to accommodate front roll adjustment through pressure screws. The gears are enclosed, and are set-screwed and keyed to the roll ends. Heavy structural steel members are used in the base construction, and allowance is made for toe room. Leveling screws are provided, and a heavy gage stainless steel batch pan is included as standard equipment. A summary of the mill's dimensions and operating characteristics follows:

Rolls:	
Length, in.	16
Diameter, in.	6
Wall thickness, in.	1⅛
Journal dia., in.	3¼
Friction ratio	1.23:1
Drive unit, hp., standard	7½
Optional	10
Speed of back (fast) roll, rpm.	19.7
Over-all dimensions:	
Height, in.	58½
To roll centerline, in.	48
Depth, in.	29
Width, in.	37½

Todd's laboratory processing mill.

Readers' Service Item E-2

SE-2517 dielectric preform heater.

Dielectric Preform Heater

A one-kilowatt output dielectric preform heater operating on a frequency of 27 megacycles and a single-phase voltage of 115 volts has been introduced by Scientific Electric Co. Called the Model SE-2517, the unit accommodates preforms up to six inches square and from ½-2½ inches in thickness. It is designed in accordance with J.I.C. standards for heavy-duty industrial service.

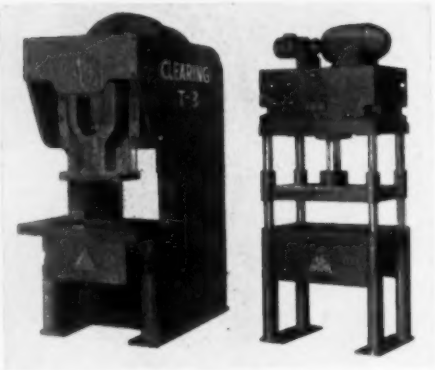
A precision-built electrode-adjusting device facilitates easy exterior adjustment of the upper electrode. The preform-draw slides on graphite-bronze bearings, thus assuring smooth, trouble-free operation. Heating time is controlled by a special cycle-flex timer. The unit measures 16½ inches wide by 18 inches deep, and is 42 inches high.

Readers' Service Item E-3

Flash Trimming Presses

A low-cost line of trimming presses for the removal of parting line flash from metal and plastic die castings, has been introduced by Clearing Machine Corp. Available in both mechanical and hydraulic models, the presses combine a large working area with low tonnages. Bed areas range from 32 by 18 inches to 36 by 24 inches; slide areas from 18 by 12 inches to 34 by 20 inches; and capacities from 30-75 tons. Frames are of welded steel construction permitting a lighter framework while maintaining favorable deflection standards. Provisions have been made to facilitate handling with a crane or fork truck.

The mechanically operated units feature gap-type construction and operate at selected speeds ranging from 30-120 strokes per minute. Stroke lengths range from 3-12 inches, and shut heights from 13-20 inches. A key-locked selector switch permits single stroke, inch, or continuous operation. The combination clutch and brake unit is air-operated, and the two components are separated by an inter-



Two 30-ton trimming presses; on the left, a mechanical model; right, a hydraulic model.

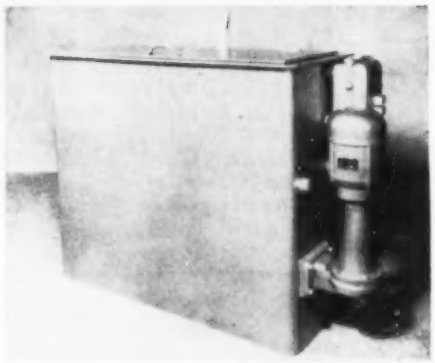
lock which prevents any overlap of action. Drive assemblies are interchangeable and may be removed as a single unit from the top of the press. Counterweights incorporated into the crankshaft, obviate the need for counter-balance cylinders. All lubrication points are served by a centralized grease system with the exception of the "knee-joint" which rides in an oil bath. A die set centering hole, located on the slide, facilitates mounting of the trim die. T-slots are provided on both the slide and bolster.

Hydraulic trimming presses are available in column-, deluxe column-, and gap-types; all of which have large bed and slide areas and are provided with T-slots. In the standard model, slide movement is controlled by a hydraulic lever located on the front of the press. The slide reverses at the bottom of the stroke when a preset tonnage has been reached. An electrical control panel is available as optional equipment.

The deluxe column model is a heavier press featuring an electrical control panel attached to the two front columns. Large, mushroom-type buttons control the various operations, and push-buttons are provided for starting and stopping the motor and for engaging the pump. Limit switches are available as optional accessories for reversing the slide at the top and bottom of the stroke, and to decelerate it on approaching the work. Another optional feature is a safety device consisting of a photo-electric cell which may be installed on the control panel to cover the front access to the working area. If any part of the beam is broken, the press will stop and remain inoperative until the obstruction is removed.

The gap-type press has a fully enclosed frame design offering free access to the working area from the front and sides. The crown, supported by a pair of pedestals extending from the bed, encloses the motor, pump, and tank. Two tie rods provide additional strength and serve as guides for the slide. Off, inch, and run operations are controlled by a selector switch, and optional limit switches may be incorporated for stroke reversals and slow-down.

Readers' Service Item E-4



Deco Model 68 mask washer.

Semi-Automatic Mask Washer

A low-cost semi-automatic mask washing machine, designated Model 68, has been announced by Deco Tools, Inc. Constructed of 12-gage steel with a non-ferrous top, the unit has no internal piping to clog or fill with paint residue. The machine has removed up to 25 coats of wet lacquer from a mask in 15 seconds, washing it on both sides with an impingement pressure of more than 20 psi. An Ingersoll-Rand side-mounted, seal-less pump is used to circulate the solvent. The pump is driven by a 220/440 volt, 3-phase, 60 cycle, explosion-proof motor meeting all J.I.C. and N.E.M.A. standards with respect to operation in hazardous areas. Other electrical characteristics may be incorporated into

IMPCO HA8-275

750 Dry Cycles Per Hour at Full 14¼" Stroke with this 8-10 ounce machine

Send today for Bulletin P-114.

IMPCO

IMPROVED MACHINERY INC.
Nashua, New Hampshire

In Canada,
Sherbrooke Machineries Limited,
Sherbrooke, Quebec

Export Distributors: OMNI PRODUCTS CORP.
460 Fourth Avenue, New York, New York

the drive unit, which is actuated by a manually operated explosion-proof switch. Specifications for the Model 68 washer include:

Dimensions, in.:	
Overall length	44
Width	18
Height	36
Cleaning space, length	34
Width	12
Height	15
Solvent capacity, gals.	35
Floor space, sq. ft.	5½
Shipping wt., lbs.	300

Readers' Service Item E-5

Hydraulic Die Lift Table

A manually-operated, portable, hydraulic lift table, designed for positioning dies and transporting other heavy objects, has been placed on the market by Crown Controls Co., Inc. Known as Model L-157, the unit rolls on hard rubber wheels and swivel casters to provide the maneuverability necessary for limited aisle-space operation.

Power from the hydraulic cylinder is transmitted to the table through a leaf-type lift chain rated at 12,000 pounds. Other features of the L-157 include a toe-controlled floor lock, and a clevis on the underside of the table for lifting loads that are flush with the floor. Specifications for this model are:

Capacity, lbs.	1,600
Lifting height, in.	36
Over-all height, in.	6
Platform dimensions, in.	34 x 31
Wheel diameter, in.	5
Caster diameter, in.	4

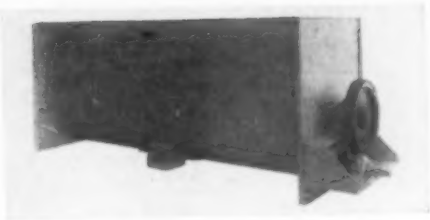
Model L-157 hydraulic lift table.

Readers' Service Item E-6

Feed-Mixer Roller Drive

Rapids Machinery Co.'s entire line of Marion horizontal feed mixers is now available with roller chain drive, as well as with the regular gear drive. Further, conversion kits can be obtained by present users of Marion mixing equipment, which will enable them to change to a silent, more efficient, and more easily maintained drive.

Both roller chain-driven and gear-driven Marion Mixers are available in capacities of 300, 500, 1,000, 2,000, 3,000, 4,000, 6,000, and 8,000 pounds. They have found extensive use throughout the plastics and chemical industries.



Marion horizontal feed mixer.

Readers' Service Item E-7

"Colloid Corner" by COLUMBIAN

High Hiding Power makes the Message Clear!

When carbon paper receives the impact of the typewriter key, only a fantastically thin layer of wax-carbon dispersion is transferred to the copy paper. Yet this layer can provide the hiding power for clear, black reproduction . . . dramatic evidence of carbon black's ability to absorb the complete spectrum. Inks, paints and plastics are a few of the products which utilize this property of carbon black. Columbian Carbon Company can provide colloidal carbons with particle sizes from 9 to 90 millimicrons. These may have rough surfaces or smooth, high or low structure and controlled degrees of adsorption and absorption. All these qualities—and more—can be varied to custom-make a wide and useful variety of distinct colloidal carbons. Consult us about your application. Use our richness of experience—it is at your service. Or send now for our free technical booklet on properties of carbon blacks.

For Progress in Colloids

COLUMBIAN CARBON COMPANY
380 Madison Avenue, New York 17, N. Y.
CARBON BLACKS · SYNTHETIC IRON OXIDES · DISPERSIONS
COLUMBIAN Carbon Blacks are available in three forms: POWDER • BEADS • DISPERSIONS

JANUARY
1958

DOW

Plastiatrics

DOW'S CLINICAL APPROACH TO HEALTHY PLASTICS APPLICATION

EFFECTIVE CONTROL OF VARIABLES DEVISED FOR INJECTION MOLDING OPERATIONS

AUTOMATIC ADJUSTMENT IMPROVES QUALITY AND UNIFORMITY OF MOLDED PARTS

Frequent mention has been made in the past few years of using a pressure signal to control the operation of an injection molding machine directly from the plasticized zone. This would help to regulate the pressure and temperature sequence precisely and uniformly in the injection mold. Needless to say, a superior quality of molded parts would result.

Dow Plastics Fabrication engineers have examined several of the possibilities and have tested the following control on which U. S. Patent 2,786,234 was obtained.

The system used for controlling the injection pressure consists of: (1) an instrument placed in the mold to measure the plastic pressure; (2) a recorder with pneumatic control; (3) an air operated relief valve connected to the hydraulic line of the molding machine. Figure 1 gives you a graphic view of the installation of such a system.

With this automatic controller, setting controls becomes easier and time and material required to get the mold into production are saved. Flashing and short shots do not occur following an interruption in the normal molding cycle. Changes in material or viscosity are taken in stride without readjusting the controls. Finally, uniformity of piece weight is excellent.

This particular system works effectively on heavier types of moldings. But, to mold thin-walled parts where faster cycles are necessary, superior injection molding depends largely on the placement of the pressure transducer. Whether you consider placing it directly in the mold cavity, in auxiliary cavity, the runner system, or in the nozzle, each location must be thoroughly evaluated for its respective advantages and drawbacks.

The machine used in testing the effectiveness of the system was equipped with a weigh feeder whose accuracy was ±.6 grams of the granular feed. When molding this part on a conventional cycle, the variations in the weight of the part were ±.4 grams. But, by using the pressure control system, these variations were reduced to ±.16 grams. See these results in Figure 2. This is only one of a number of advantages to be derived from the pressure control system.

Plastiatrics studies and research continue in this area and similar fields in an effort to find practical solutions to problems in plastics formulation, design, molding and finishing. For your copy of our technical bulletin entitled "Pressure Control for Injection Molding Machines", write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Dept., 1518G.

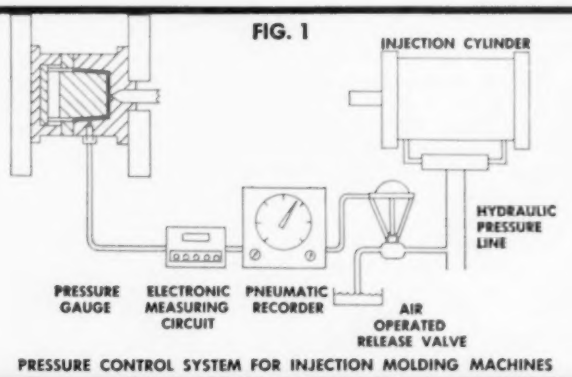
AMERICA'S FIRST FAMILY OF POLYSTYRENES

GENERAL PURPOSE
- STYRON 666
- STYRON 666M (Easy Flow)
- STYRON 665 (Extrusion)
- STYRON 689 (Easy Flow)

HIGH IMPACT
- STYRON 475
- STYRON 475M (Easy Flow)
- STYRON 777 (Medium Impact)
- STYRON 440 (Heat Resistant)
- STYRON 480 (Extra-High Impact)

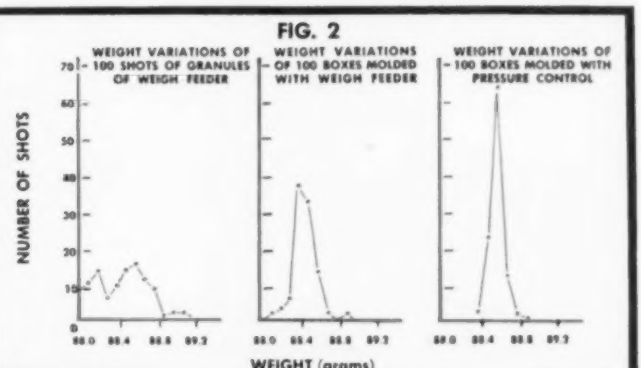
HEAT RESISTANT
- STYRON 683
- STYRON 700

FIG. 1



PRESSURE CONTROL SYSTEM FOR INJECTION MOLDING MACHINES

FIG. 2


WEIGHT VARIATIONS OF 100 SHOTS OF GRANULES OF WEIGH FEEDER
WEIGHT VARIATIONS OF 100 BOXES MOLDED WITH WEIGH FEEDER
WEIGHT VARIATIONS OF 100 BOXES MOLDED WITH PRESSURE CONTROL
NUMBER OF SHOTS
WEIGHT (grams)

YOU CAN DEPEND ON DOW

Plastics Applications

Write item numbers on Readers' Service Card to obtain more information.

Butyrate cover for fluorescent bulbs.

Extruded Butyrate Tubes

Clear tubes extruded of Eastman Chemical's Tenite butyrate are being used as covers for fluorescent bulbs in factories and laboratories. Tough and highly shatter-proof, the covers contain the broken glass, mercury vapor, and other contaminants; thus helping to prevent hazards resulting from lamp breakage or explosion.

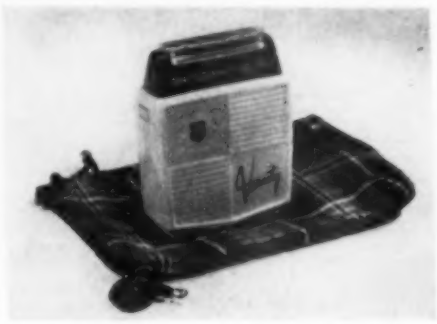
Installation is simple. The user simply slips them over the fluorescent tubes and seals them with narrow tape. Anchor Plastics Co., Inc., extrudes the covers to customer specifications on quantity orders.

Readers' Service Item P-1

Melamine-Housed Shaver

The Varsity, an electric shaver designed by Schick for younger men, features an ivory melamine housing. The clip-on shaving head is thermoplastic, and is available in red, green, blue, and charcoal. Melamine used in this application is Cymel, a product of American Cyanamid Co.

Molders of the Cymel shaver housing are Shaw Insulator Co., and Consolidated Molded Products Corp. The material is resistant to heat, staining, and scratching.



Schick's new Varsity shaver.

Readers' Service Item P-2

Nylon Spray Gun Body

Major feature of a spray painting outfit recently introduced by the Electric Spray-fit division of Thomas Industries, Inc., is a molded nylon spray gun body. Light, tough, and easy to clean, it is also stronger than its die-cast aluminum predecessor.

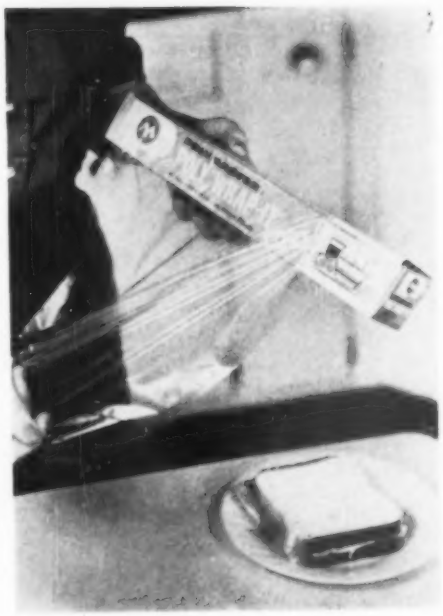
The molded body integrates three former parts into one, and eliminates six machining operations. Weight is five ounces, as opposed to 15 ounces for the aluminum body. Plastic-to-metal screw-threaded joints help to guard against loss of air pressure. The gun body is injection molded by Chicago Molded Products Corp., using Du Pont's Zytel nylon resin.

Spray gun features nylon body.

Readers' Service Item P3

Polyethylene Film Wrap

Transparent polyethylene film for home use is available from Polymaster, a division of Cello-Masters, Inc. Packaged in handy roll form, and in a box with a serrated edge, the film is strong and flexible even at freezing temperatures. Foods are kept moist, even though the wrapping may be opened several times. The thin, lightweight film comes in a roll 11½ inches wide by 25 feet long.



Poly Wrap-It polyethylene film comes in handy box for home consumption.

Readers' Service Item P-4

Vinyl Battery Service Kit

A battery service kit, rotationally cast in one piece from B. F. Goodrich's Geon vinyl plastisols, is available from Sun Rubber Co. It combines water reservoir, syringe, and cell-charge meter, thus affording faster battery check-ups. Lightweight but rugged, it withstands hard knocks, scrapes, and the effects of battery acid, grease, oil and gasoline.

One-piece vinyl kit for battery checks.

Readers' Service Item P-5

Two-part butyrate fish lure.

Acetate-Butyrate Fish Caller

An underwater buzzer known as the Krafty Fish Caller has been molded from Eastman Chemical's Tenite butyrate by Evans-Zeier Plastic Co. Available from BirchKraft, Inc., the device consists of a buzzer unit and a replaceable flashlight battery housed in a two-part butyrate case. The buzzer operates when the two halves are screwed tightly together.

The Krafty Fish Caller is attached to leder wire or nylon line for lowering to the desired depth. The plastic case is completely water tight, and will neither rust nor corrode.

Readers' Service Item P-6

Foamed Styrene Insulation

A new insulating material for perimeters and cavity walls has been developed by Dow Chemical Co. Called Scorbord, the product is a black, smooth-surfaced board of expanded polystyrene measuring one inch thick by two feet wide by eight feet long.

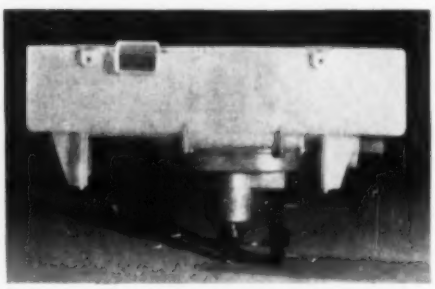
To facilitate fabrication, three prominently-marked striations are cut the length of each board at the three-, 12-, and 20-inch marks across its width. This permits the installer to snap off widths of three, four, eight, nine, 12, 17, 20, and 21 inches, as well as utilize the original 24-inch width. Scorbord is available at the same price as Styrofoam.

Readers' Service Item P-7

Nine widths are possible with Dow's Scorbord.

Polyethylene Dispensing Unit

The new automatic washers manufactured by Dole Valve Co. feature an interesting application for plastics—a liquid dispensing unit whose body, lid, and spout are molded of high-density polyethylene. Material used is Hi-fax, a product of Hercules Powder Co., which is both dimensionally stable and can be held to close tolerances. The large reservoir holds fabric conditioning liquid, which is dispensed automatically at the proper points in the washing cycle.



Hi-fax dispensing unit for automatic washers.

Readers' Service Item P-8

Butyrate Jet Charging Unit

A new jet charger featuring a clear butyrate body has been introduced by Jacuzzi Bros., Inc. Designed to maintain a constant air cushion in pressure tanks, it has a tube at its base for direct connection to the pump intake. As air in the tank is absorbed by water it is automatically replaced by the charger, thus eliminating the frequent starts and stops of the pump motor.

The charger can be used with centrifugal, rotary, gear, deep- and shallow-well jet, or turbine pumps. It operates on a pressure differential between pump section and tank, but does not require a vacuum or sub-atmospheric pressure at the pump. Eastman's Tenite butyrate, molded by American Molding Co., is used for the transparent charger body.

Butyrate charger body permits complete visibility.

Readers' Service Item P-9

Reinforced Plastic Swim Pool

A reinforced plastic swimming pool, measuring 92 feet long by 36 feet wide, has been installed at the Red Lion Country Club in York, Pa. Said to be the largest of its kind in the world, the pool was built by Paradise Pools, Inc., using Reichhold Chemicals' Polylite polyester resins. Glass fibers supply the reinforcement.

Prefabricated in 100 sections, the 3-11-foot deep unit was assembled on location. Reinforced plastic pools reportedly cost 10% less than pools made from other materials, and maintenance costs are only 10% of those for the other type pools. Leakproof and crackproof, they feature built-in color and do not require painting.

Paradise's home pools are the 15- by 30-foot Fontainbleau, the 15- by 35-foot Algiers, and the 15- by 42-foot Emerald. All can be installed in less than a week.

World's largest reinforced Plastic pool.

Readers' Service Item P-10

Opaque, Colored Safety Glass

Colorfast, pigmented vinyl sheets are laminated between two sheets of window glass to produce Colorspan, an architectural material which meets all safety specifications. Available from Mondial United Corp., Colorspan can be purchased in ten opaque and two translucent decorator colors: royal blue, moss green, tangerine, gun metal gray, walnut, kelly green, yellow gold, white, pearl gray, and claret.

Proven flameproof through accelerated weathering tests by the U. S. Electrical Laboratories, it never needs refinishing. Less expensive than colored, tempered glass, it compares in price with ordinary safety glass, porcelanized steel, wood, and plastic paneling. Colorspan is offered in stock sheet-glass sizes, or cut to specifications. Maximum stock sizes are 46 by 94 inches, and present thicknesses range from 13/64-¼ in.

Colorspan safety glass used as interior partitioning.

Readers' Service Item P-11

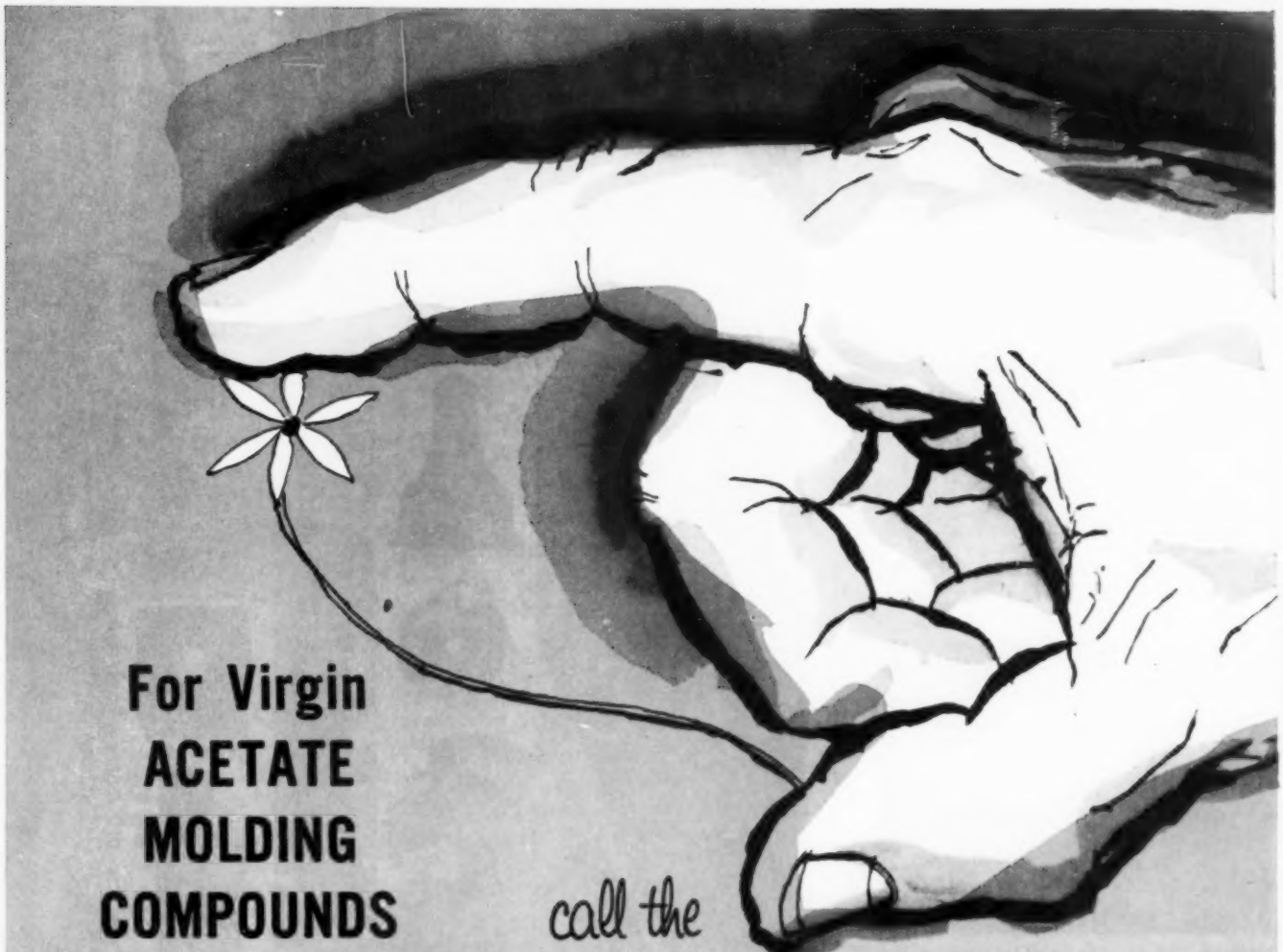
Polyethylene Houseware Item

A one-pint measuring pitcher has been added to Victory Mfg. Corp.'s V-line of polyethylene housewares. It features a double spout for both wet and dry pouring, the one not in use serving as a handle. Other features include graduated scales both inside and outside.

Victory polyethylene measuring pitcher.

Readers' Service Item P-12

A good word for quality
phenolic molding compounds
in their widest applications
is PLENCO
. . . a good word, too, for dependable counsel. Whether you take our advice or not, you can't help but profit from your consultation with Plenco's problem-solving specialists. And, in production, you can't help but benefit from the wide-ranging knowledge with which these modern molding materials are formulated and the precision with which they are produced.
Does phenolics have the answer for you? Then, chances are that Plenco compounds, in their exceptional variety, versatility and quality-controlled uniformity, can provide it. We invite you to let us demonstrate that.
PLASTICS ENGINEERING COMPANY
Sheboygan, Wisconsin
PLENCO PHENOLICS
FOR BETTER PLASTIC PRODUCTS
Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins.



For Virgin ACETATE MOLDING COMPOUNDS

call the

GIANT

with the delicate touch

Gering is a prime source for Virgin Acetate Molding Compounds formulated to **exact** flow and physical properties specifications. Available for every extrusion or injection molding need . . . in crystal and a full range of colors from the most delicate transparent to the deepest opaque.

With Gering's efficient, giant-size custom-compounding operation you can be sure of competitively priced virgin acetate of the highest quality. And you'll get speedy delivery, no matter how large your order . . . that's the Gering difference!

Over 30 years of prompt response to customer's individual needs has earned Gering an unrivaled reputation as "color compounding specialists". In addition, this service is combined with a rigid step-by-step system of quality controls, complete laboratory facilities, and modern production equipment—all under topnotch technical supervision. Write us about your specific needs today.

Check these Virgin Acetate groupings for your exact needs.

Group 1—Recommended primarily for extrusion but can also be used for injection molding. Crystals and extremely delicate transparent colors can only be furnished in this group. The full range of opaque colors and metallics are also available in this group.

Group 2—Recommended for injection molding only. For all opaque, transparent, translucent and metallic colors with the exception of crystal and extremely delicate transparent colors.

Group 3—Recommended for injection molding only. Available in the full range of opaque colors.

GERING

Molding Compounds

Virgin Thermoplastics: Vinyl • Polyethylene • Acetate • Polystyrene • Impact Styrene

GERING PRODUCTS, INC., Kenilworth, N. J. • Sales Offices: 5143 Diversey Ave., Chicago 39, Ill. • 424 Chevy Chase Road, Mansfield, Ohio

New Literature

Write item numbers on Readers' Service card to obtain copies.

"Marlex 50 Polyethylene Extruded Sheet." Phillips Chemical Co. 4 pages. Characteristics of the sheet and final products are described, and a tabulation is included which lists typical extrusion conditions and sheet properties.

Readers' Service Item L-1

"Marlex 50 Polyethylene For Injection Molding." Phillips Chemical Co. 8 pages. This bulletin is actually a reprint of an article which appeared in Modern Plastics magazine in September, 1957. Said article was entitled "Injection Molding Rigid Polyethylene," and the authors were Phillips' J. V. Smith and J. N. Scott.

Readers' Service Item L-2

"Epocast Chart." Furane Plastics, Inc. 3 pages. This chart, which opens out to one long page, lists typical physical and electrical properties for all Epocast electrical insulating materials.

Readers' Service Item L-3

"Thiokol Liquid Polymer LP-31." Thiokol Chemical Corp. 8 pages. This booklet provides property data and processing characteristics for this liquid polysulfide polymer.

Readers' Service Item L-4

"S. S. White Industrial Airbrasive Unit —Model C." Bulletin 5705. 8 pages. Deburring, abrading, and cutting by a high-speed stream of gas-propelled abrasive particles is described herein. Specifications and components of the unit are explained along with operational techniques.

Readers' Service Item L-5

"Ethylene Amines." F-8163B. Union Carbide Chemicals Co. 8 pages. Physical properties, handling techniques, and applications are listed for the firm's four amines: ethylene diamine, diethylene triamine, triethylene tetramine, and tetraethylene pentamine.

Readers' Service Item L-6

"Alpha Pipe, Fittings, and Valves." Alpha Plastics, Inc. 12 pages. This booklet describes the firm's line of unplasticized PVC piping, and lists sizes, specific applications, physical properties, temperature factors and installation techniques.

Readers' Service Item L-7

"The Ultimate in Patterns & Models." Linden Pattern Corp. 4 pages. This bulletin illustrates, in detail, many difficult and intricate patterns in both wood and metal.

Readers' Service Item L-8

"An Evaluation of Flexol Plasticizers in Nitrocellulose Lacquers." F-40080. Carbide & Carbon Chemicals Co. 4 pages. Evaluation factors are considered, test methods and formulations presented, and results charted.

Readers' Service Item L-9

"Mark Stabilizers." Technical Bulletin #1. Argus Chemical Corp. 23 pages. The bulletin deals with barium-cadmium stabilizer systems for PVC, and the applicability of various Argus Mark stabilizers to specific functions. Technical data are included for each item, and tips are given on processing considerations, formulation variables, and end use requirements.

Readers' Service Item L-10

"Butadiene Four—Carbon Building Block." Texas-U. S. Chemical Co. 52 pages. The manual contains specifications, covers 150 chemical reactions, lists end uses, and tabulates over 300 literature references.

Readers' Service Item L-11

"Why Cycolac Is Preferred for so Many Diversified Products." Marbon Chemical, Division of Borg-Warner Corp. 18 pages. This file folder contains current information on five types of Cycolac high-impact resin. Physical properties, suggested applications, and prices are included.

Readers' Service Item L-12

"Campco Data File." Campco division, Chicago Molded Products Corp. 6 pages. This booklet describes the wide selection of Campco sheet available: copolymer styrene, linear polyethylene, cellulose acetate, butyrate, ethyl cellulose, woodgrain, embossed, and Registrite.

Readers' Service Item L-13

"Heat Seal Characteristics of Polyethylene Films." U. S. Industrial Chemicals Co. 16 pages. Conditions of time and temperatures best suited to obtaining heat seals are covered. Effects of resin characteristics are explained and illustrated, and a series of graphs showing the heat-sealing characteristics of Petrothene polyethylene resins are included. The report should be of interest to extruders, converters, and packagers.

Readers' Service Item L-14

"Carbide-Tipped Saws and Cutters." CT 100. Huther Brothers Saw Mfg. Co., Inc. 12 pages. An illustrated catalog, it covers the firm's line of standard carbide-tipped saws, plus all types of special formed-tooth cutters. Huther supplies quotes and suggestions on any given job.

Readers' Service Item L-15

"Tenite Plastics Views — Color." Eastman Chemical Products, Inc. 20 pages. The importance of color in plastics, and the precautions Eastman observes to provide Tenite plastics with accurate, permanent colors, are described in this full-color bulletin.

Readers' Service Item L-16

"Copper Clad Technical Data for Better Printed Circuitry." Formica Corp. 16 pages. Printed circuits are explained, as are base laminate selection, methods of production, postforming, and circuit fabricating.

Readers' Service Item L-17

"Gallery Chemical Co." 12 pages. This illustrated booklet is designed to explain Gallery's role in chemical industry. The company history is given, products are described, and new facilities are outlined.

Readers' Service Item L-18

"Grex." W. R. Grace & Co., polymer chemicals division. 4 pages. Properties and applications for this high-density polyethylene material are given in this brochure.

Readers' Service Item L-19

Book Reviews

"Evaluation of Dry-Film Lubricant Coatings, Part I." W. C. Hart, Wright Air Development Center, for U. S. Air Force. Order PB 121922 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 29 pages. Price, 75c.

Certain dry-film lubricants were found to have as good or better high pressure- and anti-wear properties than extreme pressure oils. The dry-friction reducing films were tested for endurance and load-carrying capacity on the Falex Lubricant Tester. Materials studied were commercial baked resin-bonded films and spray can coatings with graphite or molybdenum disulfide, experimental baked resin-bonded films with molybdenum disulfide and a variety of resin bases, and air-drying coatings applied by dipping.

It was shown that the life and load-carrying ability of dry film lubricants were dependent upon the resin bonding agent used and the pre-treatment given the metal surface. Molybdenum was found better than graphite.

"Fasteners Handbook." Julius Soled. Reinhold Publishing Corp., 430 Park Ave., New York, N. Y. Cloth, 6¼ by 9½ inches, 438 pages. Price, $12.50.

All currently-available fasteners are covered in this work, and actual uses are related from industry to industry. All descriptions of proprietary fasteners have been corroborated by the manufacturers, and a vast majority of them have supplied information. Industry associations such as the Fasteners Institute and the Screw Bureaus have likewise contributed.

Each fastener has been discussed on a separate page, which includes an illustration and paragraphs headed: description, features, standard materials, uses, standard sizes, remarks, and manufacturer. Basic sections are as follows: rivets, inserts, screws, bolts, studs, nuts, washers, retaining rings, pins, nails, metal stitching, quick-release fasteners, masonry anchoring devices, hose clamps, and manufacturers directory.

"Transactions of the Society of Rheology." Volume I. Edited by Bryce Maxwell and R. D. Andrews. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. Cloth, 6¼ by 9¼ inches, 222 pages. Price, $6.00.

Subjects and authors who have contributed to this work are listed as follows: "The Tackiness of Liquid Adhesives," Hugh S. Taylor; "The Viscosity of Suspensions of Spheres," J. J. Bikerman; "Normal Stress Effect in Polyisobutylene Solutions," H. Markovitz and R. Brady Williamson; "Stress-Strain Relations in a Suspension of Dumbbells," S. Prager; "A Theory of the Viscosity of a Maxwellian Elastic Liquid," M. Mooney; "Normal Stresses, Strain Curves, and Flow Birefringence of Polyisobutylene Solutions," W. Philippoff, J. Brodnyan, and F. H. Gaskins; "Strain Aging Hydrogen Embrittlement," H. Burte; "A Stochastic Process Model for Mechanical Breakdown," B. Coleman; "Ideal Locking Materials," W. Prager; "Heat Generation and Conduction in the Flow of a Viscous Compressible Fluid," H. Toor; "A means of Measuring Viscosities of Plastisols at Elevated Temperatures," E. T. Severs and J. M. Austin; "Capillary Flow of Molten Polyethylene—A Photographic Study of Melt Fracture," J. P. Tordella; and "Proposed Nomenclature for Linear Viscoelastic Behavior," H. Leaderman.

"Effect of Thickness on Strength of Epoxy and Phenolic Laminates Reinforced with Glass Fabric." K. H. Boller, Forest Products Laboratory, U. S. Department of Agriculture. Order PB 131044 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 23 pages. Price, 50¢.

This recent study, conducted for the Air Force, indicates that the failing stress of plastic laminates decreases with decreases in thickness regardless of the type resin or reinforcement used. Materials tested included 112 fabrics laminated with an epoxy and a phenolic resin and a glass-asbestos mat with a phenolic resin. Thicknesses for three types of resin and two types of reinforcements were varied from $\frac{1}{100}$ inch to $\frac{1}{8}$ inch.

Magnitude of the stress decrease varies with the material used. Decrease for a 30-mil material, about the thinnest used in aircraft, may be as great as 12% of the strength of a ¼-inch material. The empirical relationship for the variation of tensile and compressive strengths with thickness is included in the report.

"Fire-Retardant Coatings." S. Collis, Wright Air Development Center. Order PB 131002 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 62 pages. Price, $1.75.

Commercial materials were screened in an effort to find an insulative fire-retardant coating for aircraft surfaces. This coating was to have sufficient insulation against flame temperatures of 2,000° F., to hold the temperature of the base metal to 350° F., or below. In addition, the coating had to be lightweight, easily applied, adhesive to aluminum and clad aluminum alloys, flexible at normal and low temperatures, and chemically resistant.

No commercial coating was found entirely satisfactory. The best intumescent system was a commercial coating with a top coating of vinyl resin. Boric acid, borax, and other low-temperature glass-forming materials appeared promising, especially for use in top coats. Thermosetting resins offered possibilities as binders and vehicles for the foaming reaction. Thermoplastic resins did not appear promising due to their volatility at high temperatures and the lack of a solidification mechanism.

"Concise Guide to Plastics," Herbert R. Simonds. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Cloth, 6 by 9¼ inches, 329 pages. Price, $6.95.

An excellently-written practical guide to the entire plastics field, this work covers uses, properties, costs, and trends. The writer is a former technical editor of Plastics World, and is presently a consulting engineer specializing in plastics. The book reads easily, and contains a number of handy lists of plastics producers, corporate information, and commercial trade names.

Probably the three most valuable chapters are Chapter II—Properties of Commercial Plastics, Chapter III—Forms of Plastics, and Chapter VI—Processes. Chapter II covers 32 different materials, listing their physical properties, color ranges, and typical applications. Chapter III describes such plastic forms as adhesives, coatings, extrusions, films, foams, laminates, moldings and molding powders, machined parts, and plasticizers. Chapter VI gives a brief description of most processes involved in obtaining a finished product. A number of diagrams and photos are included.

Other chapters are devoted to production and price statistics, applications, materials, selection, manufacturers' statements, and the future of plastics. This latter chapter covers the same materials as Chapter II, and predictions appear to be based on Department of Commerce statistics and forecasts by company spokesmen.

This book is the first of a series on Plastics applications, to be published by Reinhold in the near future. This series was inspired by the great interest shown by attendees at the last Plastics Exhibit, New York City, in the summer of 1956. Other books will cover Acrylics, Cellulosics, Epoxies, Fluorocarbons, Nylon, Polyesters, Vinyls, Polystyrene, and Polyurethanes.

Abstracts of Important Articles

Materials

"The Use of Metallic Soaps as Stabilizers for PVC in West Germany," Rosenthal, *Kunststoff-Rundschau*, 4, 4, 133 (April 1957).

In spite of the growing number of new stabilizers for PVC appearing on the market, West Germany continues to use large amounts of the older lead compounds and cadmium, barium, and other metallic soaps. In 1956, 54.7% of total processed PVC was stabilized with these products. The author discusses applications, advantages, and disadvantages of individual compounds, and concludes that the total consumption of metallic soaps as stabilizers for PVC will continue to rise. However, the percentage of PVC so stabilized, as compared with total stabilized PVC, is not likely to show further increase. (In German.)

"Practical Application of Experimental Results in Measuring Elastic Behaviour of Polyamide and Polyurethane," W. Weidmann, *Kunststoffe*, 47, 4, 223 (April 1957).

The practical importance of results of material testing for the construction engineer is explained. It is stressed that since polyamide and polyurethanes are being used increasingly for machinery parts, the influences of moisture content and temperature will have to be noted carefully if these plastics are to find application in the construction of economically attractive components for equipment. (In Germany.)

"Investigations on the structure of Disacryl and other Polymeric Acroleins," R. C. Schulz, *Kunststoffe*, 47, 6, 303 (June 1957).

Destabilized acrolein spontaneously changes into a white, infusible substance known as disacryl. The problem investigated was whether a real acrolein polymer could be obtained under suitable conditions that would be soluble and contain reactive aldehyde groups. It also was hoped to determine the structure of disacryl, and whether it is a macromolecular substance. Acrolein can be polymerized with the aid of various typical catalysts; the resulting polymers differing considerably in physical and chemical properties. Polyacrolein obtained by redox methods more nearly resembles disacryl, and both products yield soluble derivatives when reacted with typical carbonyl reagents. By fractionation and osmotic determination molecular weight, it could be shown that macromolecular substances were involved. A formula for the chemical structure of polyacroleins was developed and compared with accepted formulas. Research on oxidative degradation of polyacrolein is in progress by which it is expected to obtain further confirmation of the structural formula, and identify new structural elements. (In German.)

"Methacrylate Molding Materials for Large Parts," W. Kalkhof-Rose and W. Bauer, *Kunststoffe*, 47, 4, 156 (April 1957).

This is a preliminary report on a recently patented method that utilizes experience gained in the preparation of dental compounds containing methacrylate monomers and polymers to produce materials from methacrylates that can be molded at about 500° C. with a polymerization time of about 20 minutes. The low temperature usually results in low energy requirements and leads to good physical properties of the finished product. In particular, there is an absence of internal stresses, so that it becomes possible to produce large, heavy parts with greatly varying wall thicknesses. By appropriate redox systems, similar molding materials also are obtainable from acrylic, vinyl, and styrene resins and their copolymers with acrylamide and methacrylamide. (In Germany.)

"Automatic Winding of Plastic Sheet," W. Schmitt, *Kunststoffe*, 47, 5, 244 (May 1957).

A brief exposition of the winding up of plastic sheet for storage is followed by a description of a wind-up machine that incorporates a device for cleanly cutting off the sheet when rolls are to be changed, and means for quickly and automatically blowing the edge of the cut sheet against an empty roll that immediately carries the material along, so that winding is continuous. (In German.)

"Effect of some Products of the Peroxide Series on the Polymerization of Polyester Resins," P. Zanaboni and T. Cherubini, *Materie Plastiche*, 23, 3, 188 (March 1957).

The 12 catalysts to which the study was limited are the most representative and most easily identified types. Tests were carried out on Gabbropolyester PIN with polymerization at 80° and 100° C., as well as at ambient temperature. In the latter case, Montecatini accelerators N and A were employed. Results are shown in a series of time-temperature curves and in two tabulations. (In Italian.)

"On the Electrical Resistance of PVC Manufactures," A. Coen and A. Parrini III, *Materie Plastiche*, 23, 3, 216 (March 1957).

The influence was studied of the compounding ingredients (stabilizers, lubricants, fillers, pigments and plasticizers) on the electrical properties of PVC insulations. Information could be obtained as to the nature of the process of electrical conduction in PVC, and the mechanics of the actions of the different ingredients. (In Italian.)

"Molecular Weight and the Properties of Polymers," J. M. G. Fatou, *Rev. de Plasticos*, 7, 42, 278 (Nov.-Dec. 1956).

The molecules in a polymer vary more or less in size and molecular weight, with size distribution depending on the conditions of polymerization. Methods of determining average molecular weight are mentioned, and the relation of physical and mechanical properties of plastics (including polystyrene, PVC, and polyesters) to molecular weight is discussed. (In Spanish.)

HAVE YOU TRIED

Increased electrical insulation. Compatible with all types of resins. Stocks in principal cities.

U.S. MICA CO., INC.
79 PROSPECT ST.
STAMFORD, CONN.

POLYESTER F-1

A modified glycol-polyadipate specifically designed for reaction with diisocyanates to produce . . .

POLYURETHANE flexible foams & films

SPECIFICATIONS	
Acid Number	1.5 Maximum
Hydroxyl Number	58-62
Viscosity, cps. @ 25°C.	10,000-13,000
Color, Gardner	5 Maximum
Sp. Gr., 20/20°C.	1.195±0.005
Moisture, %	0.0

Evaluate RC POLYESTER F-1 in POLYURETHANE cushioning, coatings, thermal insulation, toys, sponges, jacket-liners, carpet underlays, automotive padding, rubber lacquers, wire insulation, and in hundreds of additional applications!

WRITE TODAY! Ask for our technical data sheet on RC POLYESTER F-1. We'll be glad to send you samples!

RUBBER CORPORATION OF AMERICA

READY RELIABLE RC SERVING AMERICAN INDUSTRY, SINCE 1930

New South Road, Hicksville 6, N. Y.

Sales Offices: NEW YORK • AKRON • CHICAGO • BOSTON

In this plant making plastic printing plates, each press *has its own Speedylectric steam boiler.* Each press is independent of the others, and each gets steam at the right temperature and pressure. There is no big boiler to waste power when only one or two presses are needed, and it takes only minutes to bring a press up to temperature for a rush order.

For every plastic molding operation, a Speedylectric steam generator is the ideal answer. Using the most economical method of generating steam electrically, its design eliminates low-water hazard and practically removes the need for attendance. Maintenance is nil, and there's no risk of fire or explosion. Sizes from 2 to 60 Bhp, 15 to 500 psi and higher. Requires 220, 440, or 550 v A.C. UL listed, ASME Code. For more information write Pantex Mfg. Corp., Box 660AU, Pawtucket 1, Rhode Island.

Equipment

"Hydraulic Fluids for Molding Presses," K. G. Henrikson and J. R. Hicks, *SPE J.*, 13, 11, 23 (Nov. 1957).

For use in molding presses, hydraulic fluids require good viscosity, film strength, oxidation stability, anti-rust properties, water-separating ability, and resistance to foaming. Rules are given for maintaining hydraulic fluid qualities, leakage control, and preventive maintenance.

"Mold Temperature Control—Why and How," R. W. Clarke, *Modern Plastics*, 35, 4, 144 (Dec. 1957).

Four methods of mold temperature control by means of circulating-liquid systems are given to achieve the control needed for molding parts with tight dimensional and property tolerances. The methods are uncontrolled cold water; hand-valve control; the trickle system; and the constant-velocity system of water flow.

Processing

"Factors Affecting the Heat Sealing of Polyethylene Film," R. M. Knight and W. U. Funk, *Modern Plastics*, 35, 4, 133 (Dec. 1957).

The required clamping time at a given temperature decreases as sealing pressure or resin melt index increase, or as density or film thickness decreases. The sealing of gusseted film is shown to require close attention to conditions if good seals are to be made.

"Factors Affecting Plastisol Flow," H. E. Frey, *Modern Plastics*, 35, 4, 164 (Dec. 1957).

The primary factors that affect the flow characteristics of plastisols are the resin, plasticizers, pigments, and fillers. The flow properties also are shown to be functions of the compound history, to some extent.

Applications

"A Reinforced Plastics Cash Register," Mario Petretti, *SPE J.*, 13, 11, 29 (Nov. 1957).

A discussion of an application type with special mention of the fabrication of preform screens, machining operations, and the choice of fillers and resins.

"A Survey of Materials, Methods, and Equipment for Printed Circuits," C. E. Rhine and S. M. Lewis, *Plastics World*, 15, 11, 14 (Nov. 1957).

A survey of major developments in this field, with special emphasis on production and design of printed circuits.

"Acrylonitrile-Acrylate Copolymers for Wire Insulation," J. Rosenberg and H. L. Greenberg, *Modern Plastics*, 35, 4, 173 (Dec. 1957).

Various acrylonitrile-acrylate copolymers were prepared and tested for electrical and mechanical properties. The range of properties obtainable, and inherent thermal and moisture resistance qualities, indicates that there are some useful thermoplastics in this series.

General

"Petrochemistry and the Plastics Industry," K. Winnacker, *Kunsstoffe*, 47, 8, 397 (August 1957.)

The part that petrochemistry has played and will continue to take in the rapid expansion of the plastics industry is explained. The processes developed in the United States and Germany for preparing ethylene, acetylene and derivatives, and products of direct cracking of crude oil are discussed, with special attention being given to the Hoechst high-temperature pyrolysis method for producing ethylene and acetylene. It is shown that the German chemical industry, too, can develop a process and an industry of its own based on crude oil, independent of local industries based on coal or gas, and capable of supplying all that the plastics industry requires. Presented at the 7th German Plastics Convention, April 1957. (In German.)

"Effect of Processing Conditions on Production Costs and Properties of Moldings," T. Henne, *Kunststoffe*, 47, 8, 505 (August 1957.)

The conditions for combining economy of production with required quality of moldings are explained. The factors dealt with include the forms and types of materials, degree of hardness demanded, curing time and pressure in relation to molding temperature, the preheating of raw materials, and the servicing of transfer molding machines. Presented at the 7th German Plastics Convention, April 1957. (In German.)

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines is printed here quarterly.

The next complete listing will appear in February.

SCIENTIFIC TESTING INSTRUMENTS MADE BY A FUNCTIONING LABORATORY

TESTING INSTRUMENTS for the PLASTICS INDUSTRY

TRAINED MANPOWER, IMPARTIALITY, and STANDARDIZED METHODS

We Make Them More Efficient Because We Use Them, Too!

As the only functioning laboratory manufacturing instruments, we harness the talents of the laboratory and the instrument technicians. Result: the instruments are conventional in operation, simple to calibrate, easy to maintain. They are sensitive, stable, and, in most cases, applicable to multi-purpose testing requirements. And all are pre-tested in our own laboratories.

Our instrument service is four-fold: we design and manufacture new instruments; we modify existing instruments to meet special needs; we manufacture instruments from existing designs; we operate test laboratories where impartial laboratory reports are essential. Write for our free Instrument Service Bulletin.

Stiffness Tester for pliable sheet forms

Impact Tester

Three Vital Contributions of the Independent Laboratory to PLASTICS TESTING

In so fluid and expanding an industry as Plastics, the problem of testing and research remains acute for the individual manufacturing concern.

The United States Testing Co., with its comprehensive laboratory facilities, offers such concerns important technological services in such timely aspects as:

1. Release of your valuable technical manpower to more creative efforts in more fruitful fields by assumption of the burden of your time-consuming projects.

2. Application of standardized methods to Plastics tests for more valid comparisons of material properties, manufacturing processes, and end-use performance.

3. Impartial findings in all phases of Plastics testing, offering both an invaluable objective viewpoint and a check against your own test results.

UNITED STATES TESTING COMPANY, INC.

Established 1880

1640 PARK AVENUE, HOBOKEN, NEW JERSEY

Boston • Brownsville • Dallas • Denver • Los Angeles • Memphis • New York
Philadelphia • Providence • San Angelo

Patent Digest

Materials

Epoxy Derivatives. No. 2,794,028. Benjamin Phillips and Paul S. Starcher, Charleston, W. Va. (to Union Carbide Corp., New York, N. Y.).

An epoxide selected from the group consisting of 4,5-epoxycyclohexane-1,2-dicarboxylic acid and 4,5-epoxycyclohexane-1,2-dicarboxylic anhydride.

Process for the synthesis of Acrylonitrile from Acetylene and Hydrogen Cyanide. No. 2,796,426. Gerlando Marullo, Umberto Maffezzoni, and Marco Agamennone, Milan, Italy (to Montecatini, Societa Generale per l'Industria Mineraria e Chimica, Italy).

The improvement consists of entering about 0.8-1.0 mol equivalents of acetylene per one mol equivalent of hydrogen cyanide at the bottom of a lower stratum of a column containing cuprous salts in acidified acqueous solution maintained at a temperature of 80° C. An excess of acetylene, diluted with an inert gas, is entered at the bottom of an intermediary stratum of a column maintained at a temperature ranging from 80-100° C.

Polytrifluorochloroethylene Plastic. No. 2,792,377. William T. Miller, Ithaca, N. Y.

A moldable, solid homo-polymer of trifluorochloroethylene, that is resilient, orientable, substantially inert, having a molecular weight of at least 50,000, a transition temperature of 210° C., and a no-strength temperature of at least 215° C. It is substantially insoluble at temperatures below 30° C.

Purification of Acrylonitrile. No. 2,792,415. Thomas D. Higgins, Jr., Texas City, Tex. (to Monsanto Chemical Co., St. Louis, Mo.).

A process for the removal of methyl vinyl ketone from acrylonitrile, which comprises the addition of at least one mole of hydrochloric acid for each mole of the ketone, at a temperature between 0-78° C., and recovering the acrylonitrile.

Method of Rendering Amber the Surface of Polyethylene Plastic. No. 2,793,964. Everett E. Gilbert, Flushing, and Charles B. Miller, Lynbrook, N. Y. (to Allied Chemical & Dye Corp., New York, N. Y.).

The surface of polyethylene plastic is rendered amber by contacting it with a solution of fluorosulfonic acid, sulfur trioxide, and tetrachloroethylene, and washing the surface with an alkaline substance.

Perhaloacrylyl Peroxides in Fluoro-olefin Polymerizations. No. 2,793,201. Carl I. Gochenour, William Eric Ashton, and Charles F. Baranauckas, Niagara Falls, N. Y. (to Hooker Electrochemical Co., Niagara Falls, N. Y.).

In the process for polymerizing fluorine-containing perhalo-olefins, the improvement consists of employing a bis-(perhaloacrylyl) peroxide as the polymerization promoter.

Polymerization of Trifluorobromoethylene. No. 2,793,202. John M. Hoyt, Woodside, N. Y. (to M. W. Kellogg Co., Jersey City, N. J.).

Trifluorobromoethylene is polymerized in the presence of a peroxy compound at a temperature between —10° and 25° C., to form a solid homopolymer.

Method of Making Polymeric Acids. No. 2,793,220. Fred O. Barrett, Springdale, Charles G. Goebel and Robert M. Peters, Cincinnati, O. (to Emery Industries, Inc., Cincinnati, O.).

Polyunsaturated fatty acids are heated and agitated in the presence of a crystalline clay mineral and a small amount of water until the neutralization equivalent of the polymerized products is no more than 25 units higher than their saponification equivalent. The reaction is conducted in a temperature range of 180-260° C.

Recovery of Glycols from Polyester Production. No. 2,793,235. Hugh R. Jenkinson, Galena, Md. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Ester-containing glycol vapor is condensed and the esters are saponified in the presence of a substantially anhydrous alkaline material.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Price, 25c each.

—The Editor

Removal of Cyanide Impurities From Acrylonitrile. No. 2,793,227. Alexander Sadle, Petersburg, Va. (to Allied Chemical & Dye Corp., New York, N. Y.).

Acrylonitrile is treated with a 1-5% caustic solution, flash distilled to remove lactonitrile, and then fractionally distilled to remove the remaining cyanide impurities.

Processing

Production of Extruded Shapes Having Textured Surfaces Without Recourse to External Mechanical Devices, Such as Embossing Rolls and the Like. No. 2,795,821. Thomas C. Williams, Jr., Ramsey, N. J. (to Okonite Chemical Co., Passaic, N. J.).

Extruded shapes having a textured surface are produced by fluxing and working an admixture of PVC and butadiene-acrylonitrile until the mass reaches a temperature of 340° F. After extrusion, the mixture is maintained at approximately 345-355° F. for 2½ seconds, after which it is quenched to room temperature.

Treatment of Polyethylene. No. 2,795,820. Harold J. Grow, East Orange, John H. Prichard, Springfield, and Walter D. Paist, Berkley Heights, N. J. (to Celanese Corp. of America, New York, N. Y.).

The ink adhesion of a polyethylene surface can be improved by passing it through the secondary cone of a flame having a temperature between 4,200-5,000° F.

Method of Making a Glass Fiber Reinforced Resinous Product. No. 2,798,020. Emil H. Balz, LeRoy F. Ornella, and Jaclyn Dohm Villwock, Toledo, O. (to L. O. F. Glass Fibers Co., Toledo, O.).

While forming a plurity of fine, molten glass fibers, a binder composition is applied consisting of an aqueous emulsion containing polyvinyl acetate, liquid polyhydric alcohol and an amount of acid sufficient to maintain the pH value between 2.5 and 4.0. The fibers are grouped into a strand, placed in a solution of unsaturated organo silane and polyester, and cured to form a reinforced resinous product.

Method of Making Fiber-Reinforced Plastic Parts. No. 2,794,760. James H. Wilson, Sturgis, Mich. (to Sturgis Posture Chair Co., Sturgis, Mich.).

A molded base-supporting member for a swivel chair is made by forming a mass of glass fibers into the desired shape which is temporarily retained by the incorporation of a binder. A water-soluble coating resin is applied to the surface fibers and allowed to set, after which the entire mass is impregnated with a molding resin and cured.

Patent Digest (Cont'd.)

Process of Making Foamed Resins. No. 2,797,443. Frank A. Carlson, Jr., Springfield, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

Polystyrene foams of fine pore size are extruded by blending with water a particulate styrene polymer containing pentane, and immediately thereafter extruding the material at a temperature above 250° F.

Positions Open

Classified Rates $10.00 per inch.

WANTED: Chemical Engineer; B.S. Degree; to develop and run a Slush Molded Plant; salary open; Plastic and Slush Molding experience needed. Reply to:

Box No. 97
PLASTICS TECHNOLOGY
386 Fourth Avenue, New York, 16, N.Y.

Directory

1 time	$16.50 per inch
6 times	$15.40 per inch
12 times	$13.20 per inch

Equip your used injection machine with an IMS Extra Capacity Heating Cylinder. Gain an extra margin of profit—get one jump ahead of your competitor who sticks to old style under-capacity heaters. Prompt delivery.

Don't put it off! Write today and find out how you can upgrade your present press with an IMS Heating Cylinder:

INJECTION MOLDERS SUPPLY CO.
3514 LEE RD.
CLEVELAND 20, OHIO

We are interested in acquiring manufacturing facilities for Slush Molded items. A completely equipped operating plant will be desirable, but it does not have to be in operation. Location unimportant. Reply to:

Box No. 98
PLASTICS TECHNOLOGY
386 Fourth Avenue, New York, 16, N.Y.

WANTED

SHEET EXTRUSION ENGINEER

Best man in the country to set up, purchase equipment and take full charge of Sheet Extrusion Plant. New York area, relocate if necessary, excellent opportunity, reply in confidence.

Box 100
Plastics Technology
386 Fourth Ave., New York 16, N. Y.

IN URETHANE FOAMS...

Polyesters made from Emery Polymerized Acids give

- **Superior hydrolytic stability**
- **Load deflection similar to latex**
- **Wide versatility**

If you make polyesters for urethane foams, it will pay you to formulate them from polybasic Emery Polymerized Acids because...

- Polymerized acid polyesters produce foams that resist hydrolytic degradation even in an atmosphere of live steam. Thus, breakdown of foam properties from prolonged exposure to moisture is no longer a restrictive deficiency.
- The similarity of the load-deflection of such foams to soft latex widens considerably their use in cushioning.
- Such polyesters can produce both rigid and flexible foams in uniform, high sections (4-10 ft.); can be used in one-shot or prepolymer foaming procedures; will produce foams with a wide choice of densities (as low as 1.0 lb./cu. ft.); and possess an unusually low viscosity (below 25,000 cps. @ 25° C.).

These proven advantages, coupled with the plentiful supply and low cost of the polymerized acids (25-30¢/lb. tankcars), should give Emery's Polymerized Fatty Acid a No. 1 priority in your evaluation program. Write for suggested polyester formulations to aid in your investigation of this unique polybasic acid.

Development & Service Department
Emery
Emery Industries, Inc.,
Carew Tower, Cincinnati 2, Ohio

I am interested in manufacturing polyesters from Emery Polymerized Acids. Please send me details.

Clip to your letterhead, sign your name and title, and mail to Emery Industries, Inc., Dept. Q-1, Carew Tower, Cincinnati 2, Ohio.

"A challenge to all of us"...

a statement by ***Robert B. Anderson,*** *Secretary of the Treasury:*

"The ownership by 40 million citizens of over 41 billion dollars in Series E and H Savings Bonds is a striking testimonial of confidence in America's bright future. It means security and opportunity for millions of families —a way to provide for children's education, the building of new homes, or more comfortable retirement.

"America benefits, too, from such widespread savings bonds ownership. This partnership of individual citizens in their government's fiscal operations means better management of the public debt—greater stability for our money—brighter prospects for the years ahead.

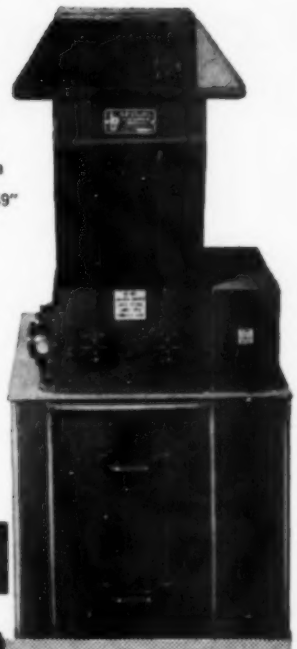
"Our country *needs* more savings—in all forms, including U.S. Savings Bonds—to help finance our growing economy; to pay for the plants and tools that mean more and better jobs for our ever-increasing population.

"Meeting this need is a challenge to all of us. Americans everywhere should be encouraged to regularly put aside part of their earnings for future needs. And certainly part of that saving belongs in the now better-than-ever U.S. Savings Bonds."

The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

PLASTICS TECHNOLOGY

M-200
300 pounds/hour
24" x 27" floor area
8" x 12" throat
hopper tray height: 49"
3 or 5 HP motor



Ball & Jewell

MARVEL SERIES
GRANULATORS

outperform all other grinders of comparable size and cost

M-75
75 pounds/hour
20" x 22" floor area
8" x 6" throat
hopper tray height: 38"
¾ HP motor

M-100
200 pounds/hour
20" x 27" floor area
8" x 8" throat
hopper tray height: 49"
1½, 2 or 3 HP motor

M-300
400 pounds/hour
30" x 31" floor area
8" x 16" throat
hopper tray height: 51¾"
7½ or 10 HP motor

Dollar for dollar, the best grinder buy on the market is a B & J Marvel Series Granulator. These features tell only part of the story:

- Heavy duty knives with double-shear knife action will grind the toughest materials — including vinyl and polyethylene — without fluffing.
- Sturdy steel construction throughout.
- Hot and cold sprues can be fed simultaneously.
- Ideal for beside-the-press or batch grinding.
- Easy to clean.

You can get the full story – write today for Bulletin M557, and, ask for details about the B & J Trial Test Plan.

BALL & JEWELL, INC.
Leaders in Granulating Machinery Since 1895
22 FRANKLIN STREET, BROOKLYN 22, N.Y.
EVergreen 9-6580
Representatives in Principal Cities

KOHNSTAMM PIGMENTS IN EVERY SHADE FOR EVERY TYPE MATERIAL

Our colors are specially treated to eliminate dusting and aid in dispersability.

Whatever your need– basic chemical pigments, cadmium colors or specially formulated and treated colorant blends...we manufacture them all.

Our laboratory is available for consultation on any color problem.

H. KOHNSTAMM & COMPANY Inc.
Experts in Color Technology for More Than a Century
89 Park Place, New York 7 — 11-13 Illinois Street, Chicago 11
2632 East 54 Street, Huntington Park, California
BRANCHES IN OTHER PRINCIPAL CITIES OF THE U. S. A. AND THROUGHOUT THE WORLD

CADET CHEMICAL CORPORATION

Lockport-Olcott Road
Burt 4, New York

Manufactures of **ORGANIC PEROXIDES**

BENZOYL PEROXIDE
LAUROYL PEROXIDE
MEK PEROXIDE

2, 4 Dichlorobenzoyl Peroxide

Descriptive Literature Available On Request.

Distributed by

CHEMICAL DEPARTMENT

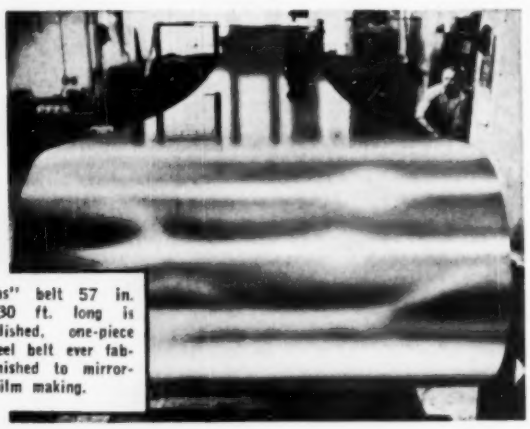
of

McKESSON & ROBBINS, INC.

155 East 44th St., New York 17, N.Y.

Warehouse Stocks in
Principal Cities

ENDLESS STAINLESS STEEL BELTS
Speed up Cooling—Setting—Conditioning of laminated work—sheets—film—coatings



"Metalsmiths" belt 57 in. wide x 130 ft. long is widest polished, one-piece stainless steel belt ever fabricated. Finished to mirror-polish for film making.

Automatic Contact Gloss

Polished stainless steel belt provides high gloss as materials move through cooling and conditioning.

Investigate continuous belt-processing for increased production and lower costs. One-piece, polished or unpolished, in any length and extra-wide sizes. Stainless steel (18-8) provides dense, corrosion-free surface. Width and camber controlled. Consult our engineers. Meetalsmiths, 557 White St., Orange, N. J.

METALSMITHS STAINLESS STEEL ENDLESS CONVEYOR BELTS

Current Market Prices

Price Changes and Additions

Glass Reinforcements

L.O.F. Glass Fibers Co.
Chrome, 60-end Roving
FBF 7100, FBF 7300
lb. $0.40 / $0.42
FBF 7500, FBF 7700
lb. .42 / .44
Garan 60-end Roving
FBF 7200, FBF 7400
lb. .40 / .42
FBF 7600, FBF 7700
lb. .42 / .44
Vitron 60-end Roving
VR-12 *lb.* .48 / .50

Fillers

Amveco asbestos fibers:
Grade A-1
ton 380.00 / 400.00
Grade B-1
ton 240.00 / 250.00
Grade C-1
ton 215.00 / 225.00
Grade D-1
ton 165.00 / 175.00

Resins & Molding Compounds

Vinyls

Geon 8635	*lb.*	.415 /	.65
8725	*lb.*	.50 /	.735
8733	*lb.*	.38 /	.615
Colors	*lb.*	.43 /	.665
8800, colors	*lb.*	.49 /	.725
8803	*lb.*	.3375 /	.5725
Colors	*lb.*	.3875 /	.6225
8817	*lb.*	.275 /	.51
8818	*lb.*	.30 /	.535
Colors	*lb.*	.35 /	.585
8825	*lb.*	.275 /	.51
8830	*lb.*	.44 /	.675
Pliovic S50	*lb.*	.27 /	.29
S70	*lb.*	.27 /	.29

CALENDAR of COMING EVENTS

February 4-6
SPI Reinforced Plastics Division Conference, Edgewater Beach Hotel, Chicago, Ill.

February 10-14
American Society for Testing Materials, Committee Week, Hotel Statler, Boston, Mass.

February 27
SPE Binghamton Section, Vestal Steak House, Binghamton, N. Y.
Northwest Pennsylvania Section, Summit Hotel, Erie, Pa.
Rhode Island and Southeast Massachusetts Section, Wayland Manor, Providence, R. I.

March 5-6
Building Research Institute, Plastics Study Group, University of Houston, Houston, Tex.

March 11
SPE Baltimore-Washington Section, Second Annual Technical Forum, Friendship International Airport, Baltimore, Md.

March 17-21
National Association of Corrosion Engineers, 14th Annual Conference and 1958 Exhibition, Civic Auditorium, San Francisco, Calif.

June 15-19
ASME, Semi-Annual Meeting, Hotel Statler, Detroit, Mich.

June 22-27
ASTM, Annual Meeting, Hotel Statler, Boston, Mass.

Domestic Production and Sales of Plastics and Resin Material. August and September, 1957

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of August and September, 1957. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

Compared with figures for the same two months last year, we find the following: cellulosics, about the same; phenolics, same; urea and melamines, up; styrenes, up; vinyls, up about 25%; coumarones, up slightly; polyesters, up; polyethylenes, up about 1/3; and miscellaneous resins, up.

	August, 1957		September, 1957	
	Production	Sales	Production	Sales
Cellulose Plastics[1]				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,600,378	1,562,281	1,716,456	1,741,554
Sheets, 0.003 gage and over	1,569,531	1,510,572	1,693,086	1,579,087
All other sheets, rods, and tubes	410,147	413,237	776,798	681,079
Molding and extrusion materials	7,200,130	7,738,728	9,098,180	8,575,053
Nitrocellulose sheets, rods, and tubes	318,219	299,674	280,523	292,430
Other cellulose plastics	511,479	464,847	495,424	457,074
TOTAL	11,609,884	11,989,339	14,060,467	13,326,277
Phenolic and Other Tar-Acid Resins:				
Molding materials[2]	12,994,406	15,719,481	14,669,119	14,470,718
Bonding and adhesive resins for—				
Laminating (except plywood)	5,541,963	4,233,740	5,224,609	4,192,817
Coated and bonded abrasives	1,327,961	1,370,655	1,335,823	1,532,816
Friction materials (brake linings, clutch facings, and similar materials)[3]				
Thermal insulation (fiber glass, rock wool)	5,243,217	5,215,938	4,411,311	4,638,526
Plywood	3,858,540	2,930,716	4,167,202	3,169,224
All other bonding and adhesive uses	4,637,261	4,847,912	4,752,208	5,202,301
Protective-coating resins, unmodified and modified except by rosin	2,256,621	2,178,014	2,652,924	2,257,161
Resins for all other uses	3,440,117	2,316,267	2,845,547	2,378,104
TOTAL	39,300,086	38,812,723	40,058,743	37,841,667
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	2,702,372	2,838,899	2,648,725	2,686,094
Paper-treating and paper-coating resins	1,864,254	1,950,042	1,867,540	1,897,138
Bonding and adhesive resins for—				
Plywood	8,272,610	7,633,680	8,665,378	8,642,992
All other bonding and adhesive uses, including laminating	3,338,887	2,808,341	2,928,178	2,886,759
Protective-coating resins, straight and modified	2,639,186	2,050,179	2,920,621	2,369,676
Resins for all other uses, including molding	7,419,159	7,434,867	7,376,318	7,747,443
TOTAL	26,236,468	24,716,008	26,406,760	26,230,102
Styrene Resins:				
Molding materials[2]	35,030,291	33,290,823	37,485,161	36,668,940
Protective-coating resins, straight and modified	6,566,463	6,145,104	6,661,105	6,651,007
Resins for all other uses	11,489,498	9,730,959	11,011,029	10,286,154
TOTAL	53,086,252	49,166,886	55,157,295	53,606,101
Vinyl and Vinyl Chloride Resins[3]				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)	—	7,120,724	—	9,406,156
Sheeting (resin content)	—	4,941,462	—	4,986,609
Molding and extrusion (resin content)	—	17,962,196	—	18,653,475
Textile and paper treating and coating (resin content)[3]	—	6,883,971	—	6,541,946
Flooring (resin content)	—	7,552,609	—	7,155,626
Protective coating (resin content)	—	2,514,788	—	2,363,211
All other uses (resin content)	—	4,251,978	—	4,189,452
All other vinyl resins for—				
Adhesives (resin content)	—	3,676,722	—	3,190,982
All other uses (resin content)	—	9,011,115	—	8,770,886
TOTAL	72,262,990	63,915,565	72,237,994	65,258,343
Coumarone-Indene and Petroleum Polymer Resins	23,513,186	23,447,900	21,680,147	21,133,962
Polyester Resins	7,335,543	7,081,189	6,663,599	6,508,103
Polyethylene Resins	58,349,389	55,340,307	60,183,806	53,107,049
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding materials[3, 4]	3,555,177	4,061,246	4,196,592	4,271,698
Protective-coating resins[5]	1,212,670	505,496	1,096,193	625,060
Resins for all other uses[6]	11,758,165	12,018,813	11,677,734	9,544,556
TOTAL	16,526,012	16,585,555	16,970,519	14,441,314
GRAND TOTALS	308,219,810	291,055,472	313,419,330	291,452,918

[1]Includes fillers, plasticizers, and extenders.
[2]Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3]Includes data for spreader and calendering-type resins.
[4]Includes data for acrylic, nylon, silicone, and other molding materials
[5]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins.
[6]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
[7]Included with "All other bonding and adhesive uses."
SOURCE: United States Tariff Commission, Chemical Division.

INDEX TO ADVERTISERS*

JANUARY, 1958

Allied Chemical & Dye Company 5
Semet-Solvay Petrochemical Division
Agency: Atherton & Currier

Argus Chemical Corporation 18
Agency: Greer Du Bois & Company, Incorporated

Bakelite Company 10-11
Division of Union Carbide Corporation
Agency: Richard La Fond Advertising, Incorporated

Ball & Jewell, Incorporated 95
Agency: Richard-Lewis, Incorporated

Cadet Chemical Corporation 96

Celanese Corporation of America 25
Chemical Division
Agency: Ellington & Company, Incorporated

Coast Manufacturing & Supply Company 20
Agency: Peter Hurst Advertising, Incorporated

Columbian Carbon Company 81
Agency: Donahue & Coe, Incorporated

Detroit Mold Engineering Company 22

Diamond Alkali Company 32
Agency: Fuller & Smith & Ross, Incorporated

The Dow Chemical Company 82
Agency: MacManus, John & Adams, Incorporated

Emery Industries, Incorporated 93
Agency: Ruthrauff & Ryan, Incorporated

Escambia Chemical Corporation 64
Agency: Godwin Advertising Agency

Flightex Fabrics Corporation 29
Agency: The Powerad Company

General Tire & Rubber Company 12
Chemical Division
Agency: D'Arcy Advertising Company

Gering Products, Incorporated 31-86
Agency: Riedl and Freede, Incorporated

The Glidden Company 17
Chemicals-Piqments-Metals Division
Agency: Maldrus & Fewsmith, Incorporated

B. F. Goodrich Chemical Company ..... Third Cover
Agency: The Griswold-Eshleman Company

Goodyear Tire & Rubber Company 1
Chemical Division
Agency: Kudner Agency, Incorporated

The Harshaw Chemical Company 69

Hercules Powder Company 26-27
Agency: Fuller & Smith & Ross, Incorporated

Improved Machinery, Incorporated 80
Agency: Hillsborough Advertisers

H. Kohnstamm & Company, Incorporated 95
Agency: Byrde, Richard & Pound

Marbon Chemical, Division of Borg-Warner Corporation 23
Agency: Holtzman-Kain Advertising

Metal & Thermit Corporation 30
Agency: Raf Advertising

Metasap Chemical Company 78
Agency: Lewin, Williams & Saylor

Metalsmith Division 96
Orange Roller Bearing Company, Incorporated
Agency: Thoma & Gill

Monsanto Chemical Company
Organic Chemical Division 14-15
Agency: Gardner Advertising Agency
Plastics Division 8-9
Agency: Needham, Louis & Brorby, Incorporated

National Lead Company 28
Agency: Marschalk and Pratt

Pantex Manufacturing Corporation 90
Agency: Richard La Fond Advertising

Phillips Chemical Company 33
Agency: Lambert & Feasley, Incorporated

Plastics Engineering Company 85
Agency: Kuttner & Kuttner, Incorporated

Reichhold Chemicals, Incorporated 19
Agency: MacManus, John & Adams, Incorporated

Rohm & Haas Company 7
Agency: Arndt-Preston-Chapin-Lamb & Keen, Incorporated

Rubber Corporation of America 90
Agency: Ovesey and Straus, Incorporated Advertising

Servospeed 71
Agency: Gordon-Pilling

Shell Chemical Corporation ..... Second Cover
Agency: J. Walter Thompson Company

Sturtevant Mill Company 75
Agency: F. P. Walther, Jr. and Associates, Incorporated

Titanium Pigment Corporation 24
Agency: Doyle, Kitchen & McCormick, Incorporated

Union Carbide Chemicals Company ..... Fourth Cover
Division of Union Carbide Company
Agency: J. M. Mathes, Incorporated

Union Carbide Corporation
Bakelite Division 10-11
Agency: Richard La Fond Advertising, Incorporated
Union Carbide Chemicals Division ..... Fourth Cover
Agency: J. M. Mathes, Incorporated

U. S. Mica Company, Incorporated 89
Agency: Terrill Belknap Marsh Associates

U. S. Testing Company, Incorporated 91
Agency: Robert B. Grady Company

United States Radium Corporation 73
Agency: Molesworth Associates

U. S. Industrial Chemical Company 2
Polyethylene Division
Agency: G. M. Basford Company

R. T. Vanderbilt Company, Incorporated 77
Agency: H. Edward Oliver

Welding Engineers 34
Agency: John Miller Advertising Agency

*This is published as a service only. Publisher assumes no liability for errors or omissions.

Another new development using

B.F.Goodrich Chemical *raw materials*

This battery service kit, manufactured by The Sun Rubber Company, Barberton, Ohio, is rotationally cast from plastisols based on Geon resins supplied by B.F.Goodrich Chemical Company.

From Geon vinyl...a unique kit for "battery doctors"

HERE'S a new, unusual product rotationally cast from a plastisol based on Geon polyvinyl raw materials. It's a compact battery service kit—handy and handsome, too. It combines water reservoir, syringe and cell charge meter for faster battery check-ups.

Because it is made of Geon, this kit withstands battery acid, water, grease, oil and gasoline. It's light in weight but rugged—takes hard knocks, bumps and scrapes. Add resistance to alkalis and most chemicals, and you have a better picture of the outstanding properties that Geon can provide for *your* products.

Products of versatile Geon can be rotationally cast, extruded, slush molded, pressed, calendered, formed and blown. Applications range from corrosion-proof piping, phonograph records and foam safety padding, to tough colorful upholstery, wear-resistant flooring and coatings for paper, textiles and metal.

For information on Geon polyvinyl raw materials, write Dept. LG-1, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

New FLEXOL 380—low cost answer to lacquer marring problems

Trade-Mark

Now, you can make vinyls with remarkable resistance to nitrocellulose lacquer marring with FLEXOL *plasticizer 380 and, you can do this at low cost.*

In the past, polymeric-type plasticizers were used to achieve freedom from nitrocellulose mar in vinyl plastics. Now, FLEXOL 380 gives you this outstanding mar resistance with improved low-temperature performance and efficiency—*and, at lower cost per pound.*

Tests* prove that the mar resistance of vinyls containing FLEXOL 380 is comparable to that obtained with commonly used polymeric plasticizers. Look at these results—

Plasticizers (at 50 PHR)	% Softening of N/C lacquer, 40°C. 1 Day	2 Days	3 Days
FLEXOL 380	<10	13	20
Dioctyl phthalate	45	60	57
Polymeric A	18	—	—
Polymeric B	17	—	—
Polymeric C	45	—	—

*with a Walker-Steele Swinging Beam Hardness tester

FLEXOL plasticizer 380 gives other performance characteristics typical of general-purpose phthalate plasticizers. It is completely compatible with vinyl chloride resins. With FLEXOL 380 you get the same excellent heat and light stability, good low-temperature properties, and outstanding electrical properties obtained with FLEXOL plasticizer DOP. Plastisols prepared with FLEXOL 380 are characterized by low initial viscosity and excellent viscosity stability.

This new CARBIDE plasticizer is useful in all divisions of the vinyl plastic industry where nitrocellulose mar resistance is a factor. Typical of the products that may benefit by the use of FLEXOL 380 are

- *lamp and clock cord*
- *furniture and automotive upholstery*
- *doll parts*
- *handbags*
- *outerwear jackets*
- *tablecloths and place mats*
- *vinyl balls and sponges*

Write for samples and technical information today. Address Union Carbide Chemicals Company, Department B, Room 328, 30 East 42nd Street, New York 17, New York. In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Ltd., Toronto.

"Flexol" is a registered trade-mark of Union Carbide Corporation.

UNION CARBIDE

CHEMICALS

Union Carbide Chemicals Company
Division of Union Carbide Corporation
30 East 42nd Street, New York 17, N. Y.